City of Amsterdam

New Amsterdam Climate

Roadmap Amsterdam Climate Neutral 2050

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Amsterdam Climate Neutral Roadmap 2050

Foreword

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Alderperson, Spatial Development and Sustainability

Can you picture it? By 2030, Amsterdam's streets will be free of exhaust-emitting cars. By around 2040, every home will have switched from natural gas to sustainable heating. And by 2050, we will have ended our dependence on coal, gas and oil. We will instead get all of our energy from the sun, wind, plants and the heat of the earth itself. For some, this is future talk or even an alarming prospect; for others, it is already daily practice. In any case, the transition to clean energy has begun and can no longer be stopped.

Why? In the first place, because of the disruption to our climate. Over the past 150 years, we've burned through the vast majority of our fossil fuels. The earth is becoming warmer as a result, with many places in the world uninhabitable due to drought, forest fires and hurricanes. What's more, melting ice is causing sea levels to rise. Although we sometimes forget it, our city lies below sea level. Yet another reason: in order to avoid more earthquakes, we want to stop drilling for gas in Groningen. The transition to clean energy is thus something we're doing for ourselves, for people elsewhere in the Netherlands and the world, and for our children.

It is not simply a question of replacing coal power with green power. The appearance of our city and its surroundings will change radically. Fossil energy came out of the ground. Clean energy – in the form of wind turbines, solar panels and heat pumps – is much more visible; think of transformer houses and power lines. It is a challenging prospect for a densely-populated city.

We will also notice the transformation at home. Electric cars are attractive and environmentally friendly, but are they affordable? Well-insulated homes are cosy, but being connected to the district heating system also means cooking with electricity. And what's it all going to cost, who's going to manage it, and when will it happen? These are legitimate questions. The municipality will take the lead on making the switch to natural gas-free housing. The basic principle is that living expenses should not rise for citizens with low and middle incomes.

Thousands of Amsterdam's citizens are already involved in initiatives and projects to save energy or generate clean energy, or to share things. People are keen to become the owners or co-owners of solar panels, independent of large energy companies. More than in the past, we will generate our energy collectively, closer to home. This will create opportunities for participation and profit-sharing.

The challenges for large companies are also considerable. The appearance of the harbour will change radically in the coming decades. Clean energy generation and storage will transform the harbour into a battery for the city, and by dismantling waste for new materials, it will become the linchpin of our circular economy.

This roadmap, *Amsterdam Climate Neutral 2050*, shows what the transition to clean energy will mean in the shorter and longer term: sometimes very specifically, because we already know what we need to do, and sometimes in outline, because although we know which direction to take, we still need to work on the details. We have already succeeded in reversing the trend and using fewer fossil fuels. The next step is for climate neutral to become the new normal. And that can't happen without you.

What is the Amsterdam Climate Neutral Roadmap?

Why

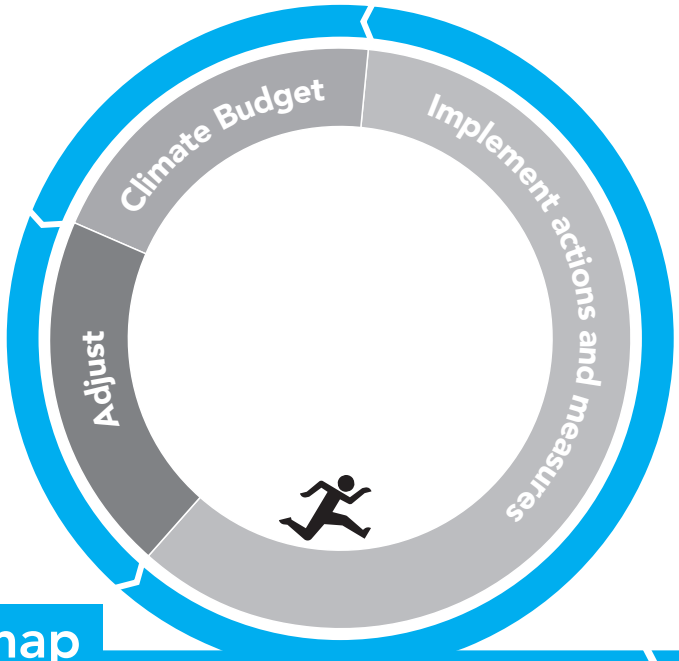
The pace of global warming is accelerating, bringing major consequences for public health, the economy and society. Climate change is the result of human action; the key to turning the tide lies in our hands. In recent years, there has been growing awareness that more and faster action is needed around the world to limit climate change, and to take measures to address it. The awareness that we cannot do it alone resulted in the Paris Agreement of 2015, which was signed by 197 countries. For the first time, the Agreement set a global upper limit of 2 degrees of warming compared to pre-industrial levels. It also set the target of limiting global warming to 1.5 degrees, and established that the consumption of fossil fuels, the most important cause of CO_2 emissions, should be phased out rapidly.

The Municipality of Amsterdam is taking its responsibility. We want Amsterdam to be a green, healthy, prosperous and future-proof city, where everyone can benefit maximally from the opportunities brought by this social transformation.

An invitation to the city

In the *Amsterdam Climate Neutral Roadmap: An invitation to the city*, published in January 2019, we outlined what we consider to be important and why. By 2050, we want to have cut CO_2 emissions by 95% compared to 1990 levels, and we want Amsterdam to be a natural gas-free city by 2040. As a step on the way to 2050, we want to cut CO_2 emissions by 55% in 2030. We want to save as much energy as possible and generate sustainable energy.

The 'invitation to the city' marked the start of an intensive process of research and negotiations with residents, companies and institutions on how to manage this massive social transition. The Amsterdam Climate Agreement was signed and a new online platform was launched, nieuwamsterdamsklimaat.nl, with more than 200 initiatives for a sustainable city. The draft version of the Roadmap has been shared widely with partners in the city, and supplemented with the many responses we have received. All of this knowledge and experience forms the basis of the *Amsterdam Climate Neutral Roadmap 2050*.



Implementation of Roadmap

Ongoing conversation with the city

Knowledge-development and innovation

2020

Amsterdam Climate Neutral Roadmap 2050

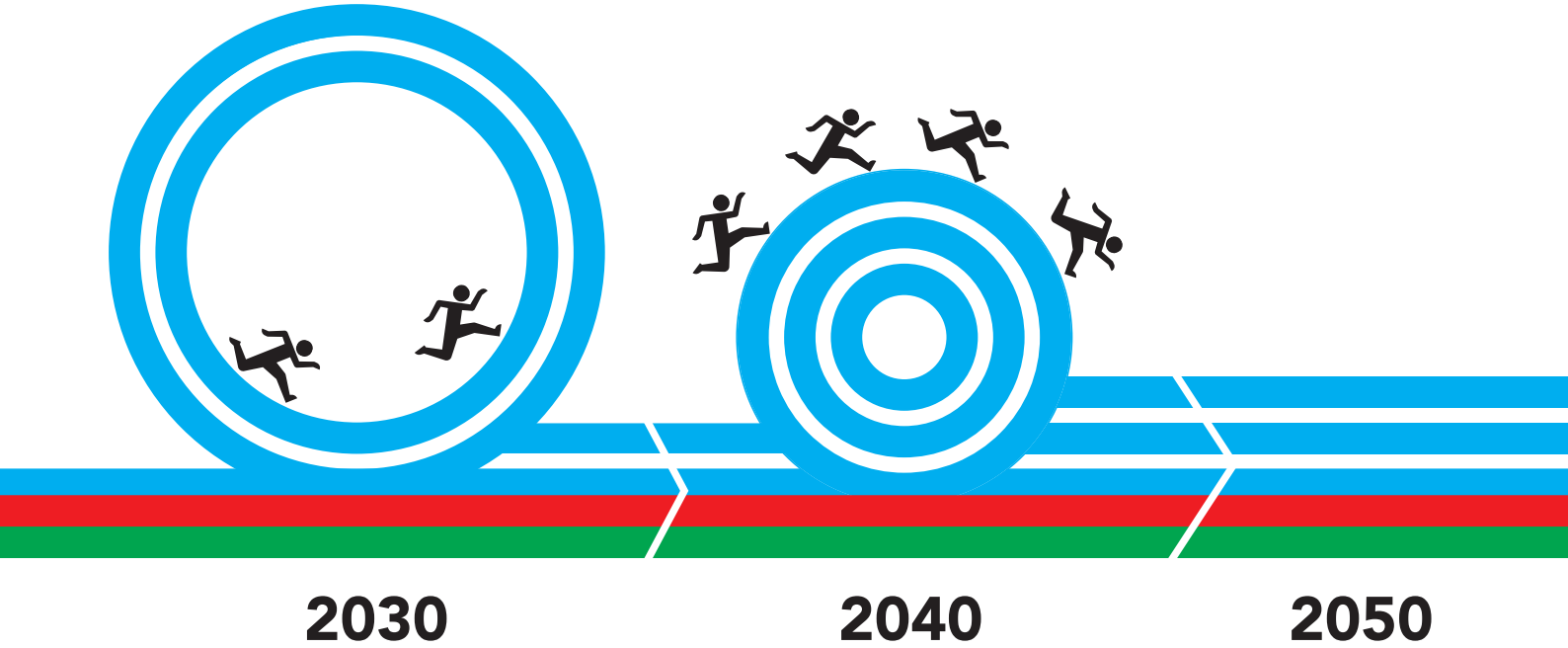
The Amsterdam Climate Neutral Roadmap is an ambition document that sets out a vision of the energy transition in Amsterdam in the long term, and the actions to be taken in the short term. In the Roadmap, we describe the most important elements of our strategy for collectively launching and maintaining the transition from fossil fuels to renewable energy.

We outline the challenge ahead and the impact of the measures, manage the transition using a Climate Budget, and describe our approach, which is based on four transition paths: (1) Built Environment, (2) Mobility, (3) Electricity and (4) Harbour & Industry. Each transition path contains a number of pillars, on which the approach is based. In sixteen pillars, we describe what we will do during this municipal term to achieve the desired carbon reduction. In four additional pillars, we describe the extra preconditions that are needed to meet the intended targets: strengthening the movement in the city, climate justice, knowledge development & innovation, and space & infrastructure.

The Roadmap marks the start of a flexible process that will entail intensive collaboration in the city, experimentation, data-gathering and learning, allowing us to adjust our approach where necessary. The developments and progress will be covered in the annual reports.

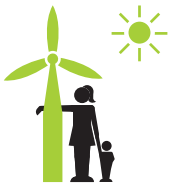
What is an energy transition?

In this Roadmap, we often use the term 'energy transition'. By this, we mean the transition from a world in which we are dependent on fossil fuels to a world in which we only use energy from renewable, and thus perpetually available, sources. It will require a broad social transformation, which will have an impact on our economy and on our daily lives.



The challenge at a glance

Current greenhouse gas emissions in Amsterdam



Total emissions
5.000 kton CO_2 equivalents

100%

Built Environment

25%

Natural gas and heat consumption and other greenhouse gasses

Housing 14%

Business market 7%

Social & civic buildings 4%

Mobility

18%

Fuel consumption

Roads in Amsterdam 9%

Motorways 6%

Mobile machinery 2%

Ferries, recreational boats and disel trains 0.2%

Other greenhouse gasses 0.6%

Electricity

39%

Electricity consumption

Business market 21%

Housing 8%

Social & civic buildings 6%

Industry 4%

Harbour & Industry

18%

Waste incineration 11%

Natural gas and heat consumption industry 5%

Fuel consumption inland shipping and fishing 0,5%

Other greenhouse gasses industry 1.5%

Support

Attitude of Amsterdam's citizens to the transition to renewableenergy (2019)

Positive	Neutral
75%	14%
Negative	**Don't know**
9%	3%

Energy poverty

% of low-income households (eligible for housing benefit) that spend more than 10% of income on energy costs (2017)

31%

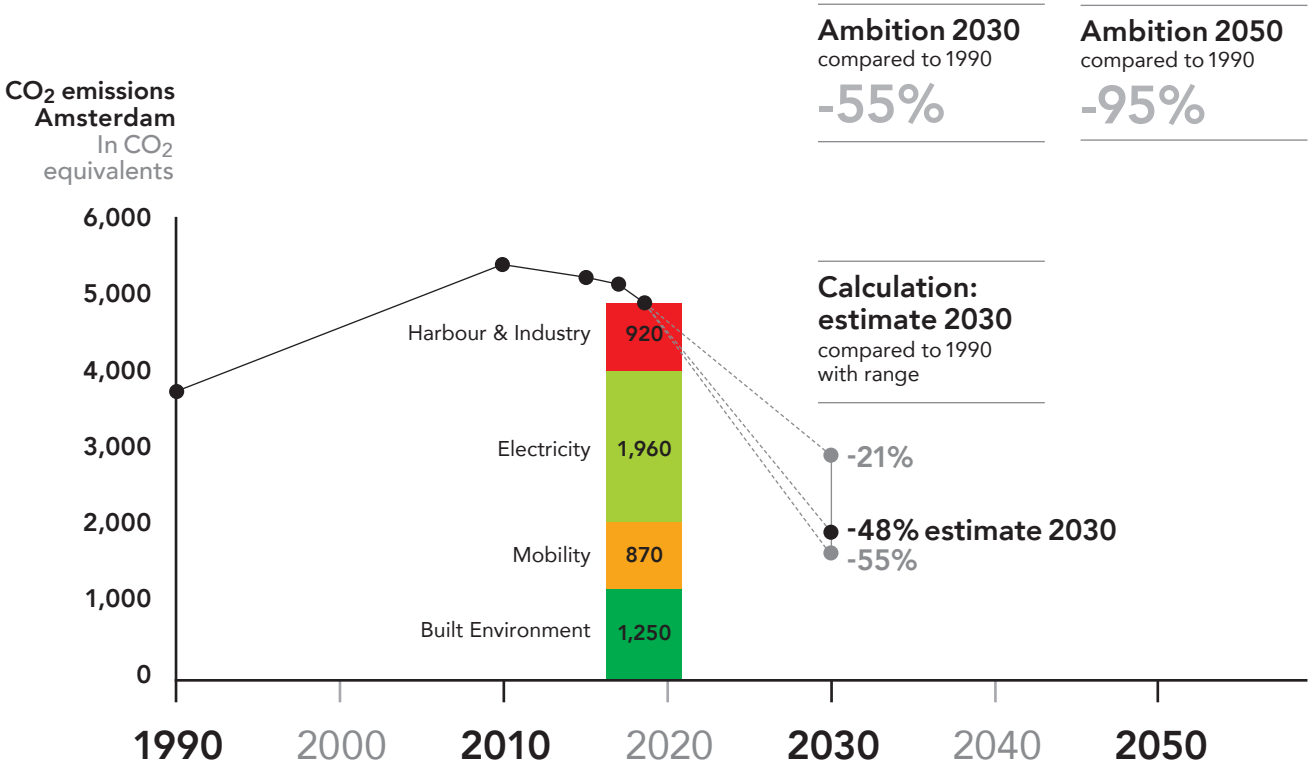
Generation of renewable energy in Amsterdam

Installed capacity (MW)

2019	Ambition 2030
73	550

2019	Ambition 2030
66	127

Calculation of remaining greenhouse gas emissions in Amsterdam in 2030



Notes on greenhouse gas emissions in Amsterdam

Past and present

Amsterdam emitted 3,810 kt of greenhouse gases in 1990.

Due to the growth of the city, by 2010 these emissions had risen to 5,510 kt.

Emissions have fallen in Amsterdam since 2010, despite the continued growth of the city, thanks to more sustainable generation of electricity and falling energy consumption per resident.

2017 is the most recent year for which we have a full picture of the emissions figures for Amsterdam; in that year, emissions were 5,000 kt.

Future

Based on a calculation of all of the planned activities and measures by central government, the Municipality of Amsterdam and citizens, companies and institutions, emissions are expected to fall by 48% in 2030, compared to 1990.

Given the uncertainty surrounding how far we will succeed in implementing the planned actions and measures, and the size of the effects, a range has been included.

The range of the calculation is between -21% and -55%.

Our ambition of a 55% cut therefore lies within reach.

In order to achieve this ambition, all actions and measures must be implemented successfully and in full. Many actions and measures still need to be worked out, and policies have to be developed and adopted. Additional measures must also be taken.

Contents

Chapter 4

What needs to be done?

Note to readers

In chapter 1 of the Roadmap, we present our vision of the energy transition in Amsterdam, and describe the most important elements of our strategy to launch and maintain this transition from fossil fuels to renewable energy.

In chapter 2, we describe our systematic approach and how we work with the Climate Budget. This chapter forms the quantitative part of the Roadmap, providing insight into the figures and the effects of the proposed measures.

In chapter 3, we describe our substantive approach, which follows four transition paths: (1) Built Environment, (2) Electricity, (3) Mobility and (4) Harbour & Industry. Each transition path consists of a number of pillars, sixteen in total, in which we describe the actions we will take to cut carbon emissions as intended.

Finally, in chapter 4 we describe a number of pillars containing measures that will not lead directly to fewer carbon emissions, but that will be crucial for the energy transition in Amsterdam: collaboration, climate justice, innovation, space and energy infrastructure. Chapter 4 also focuses on a number of critical preconditions, such as financing and regulations.

A separate public version of the *Amsterdam Climate Neutral Roadmap 2050* is also available.

Mehrdad Gholani

Interpreter and proud resident of the Zuidoost district

"When it comes to sustainability, I'm a beginner. My reasons for trying to save energy are mainly economic, such as buying low-energy lightbulbs or turning down the heating. There aren't any solar panels on this building. I think that's something the housing corporation or municipality should sort out."

"For the last few months, we've had separate refuse containers for different kinds of waste in our street. That's motivated me to start separating waste. I think that's how it works for other people, too. The municipality takes the first step, showing us we're worth it by investing in our neighbourhood, and then we have to take the next step. Zuidoost has really changed as a result. It's lovely and green here, and people like walking outside in the summer. I think that if people are happy, if there are low levels of crime or unemployment, then they are more prepared to get involved in sustainability issues."

"When it comes to sustainability, I'm a beginner. For some things, such as separate refuse containers, I think that the municipality should take the first step, by providing facilities. Then the citizens should take the next step."

"In the future, I want to separate my waste more and buy things more consciously, whether it's a new pair of shoes or a car. But I think that electric cars are still way too expensive."

Chapter 1

Vision and strategy

1.1

What if we do nothing?

Around the world, floods, changing temperatures and drought are having a significant impact on public health, the economy and society. If we do nothing, Amsterdam will also be hit hard by the consequences of climate change. In the meantime, we see that action does have promising results.

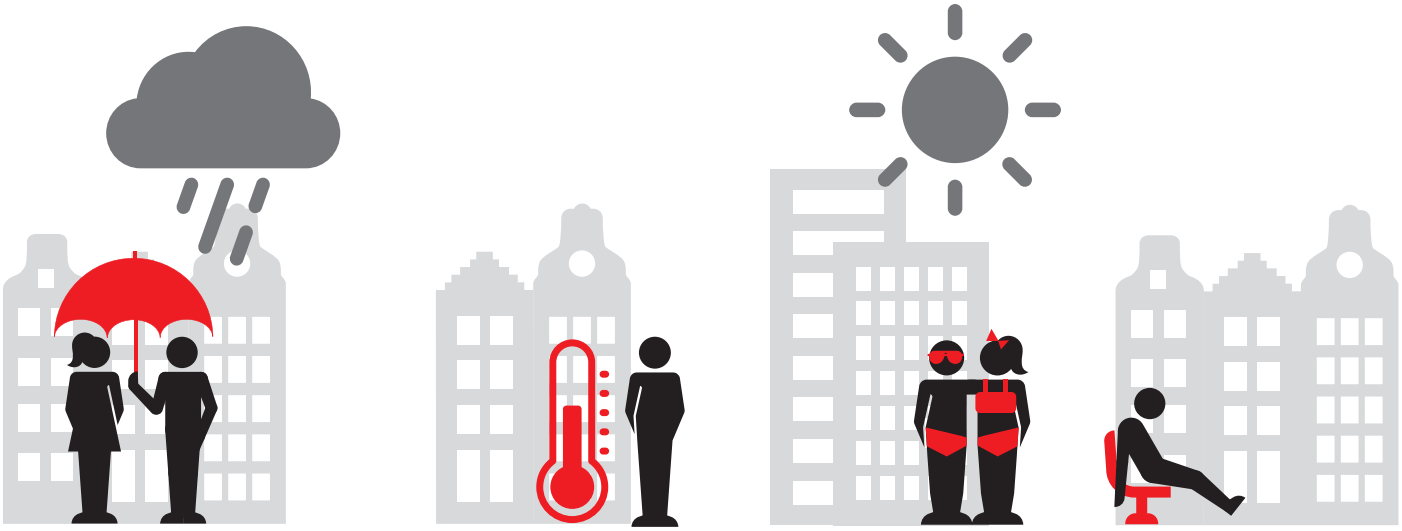
If we do nothing, the fall in biodiversity will pose as much of a threat to humanity and our ecosystem as the climate crisis. Global warming leads to the extinction of animal and plant species, upsetting the dynamic balance of ecosystems. Dysfunctional ecosystems threaten our supply of food and raw materials, clean drinking water, oxygen (produced by plants) and coastal protection (provided by sand-dune formation and mangrove forests). Monocultures pose a threat, because they are more vulnerable to disease and plagues. It is becoming increasingly expensive to tackle the impact of ecological disasters and respond to the consequences of climate change.

People who live in poverty or people with a vulnerable socio-economic status run a greater risk. The prospect of wars and large refugee flows looms when parts of the world become uninhabitable due to the lack of clean drinking water, or the impossibility of cultivating enough food. Hundreds of thousands of people are already fleeing rising water levels, drought and conflicts every year.

Consequences for Amsterdam

If we do nothing, Amsterdam will also be hit hard by the consequences of climate change. Then we will have even more heatwaves; the temperature in the warmest month will probably be 3 degrees Celsius higher than now. Peak temperatures during heatwaves will also rise sharply. Around 2050, we will have more than twenty tropical nights per year, on average, compared to seven now. Heat stress affects our health.

The elderly, infants and people with chronic conditions are particularly affected by the negative consequences.



More rainfall with more frequent, heavier downpours Increasingly wet due to over 6% more rainfall

Since 1950, the average temperature has risen by 1.6 °C

An increase to 40 summer days is expected by 2085

Heat stress and sleep disruption

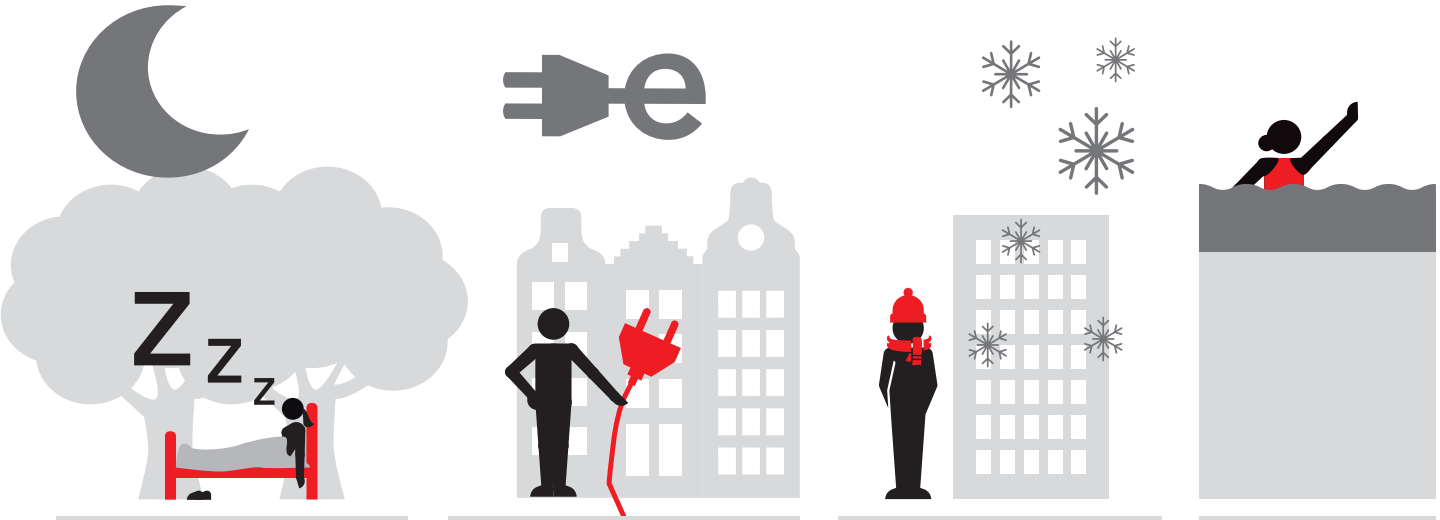
Sleep disruption prevents us from getting adequate rest, with all the implications this has. During hot summers, mortality rates will rise, and people will be more at risk of developing allergies and catching 'tropical' infectious diseases.

There will be fewer frosts, and skating on the canals will become a distant memory. There will be increased rainfall, with more frequent heavy downpours. Our climate – and thus also our country and our city – will become wetter, with more than 6% more rainfall. The demand for energy will rise. If we do nothing, power failures will disrupt production processes and throw public life into disarray. The sea level is expected to rise by a maximum of 85 cm this century, and flooding will have major consequences for humans and the environment. If the AEB waste-to-energy plant is flooded, at least 35,000 households and companies will be left in the cold.

In the meantime, we see that action does lead to promising results. Despite the growth of the city, CO_2 emissions in Amsterdam have fallen since 2010, and we are using more and more clean energy. Not content with doing nothing, residents and entrepreneurs are taking action. The city is bustling with initiatives – some small, some larger. Results are being achieved and others are being inspired to take part. There is considerable support for the measures among Amsterdam's citizens.

Stopping global warming is of course dependent on the measures and actions taken by a great many parties around the world. Only if everyone plays their part will we be able to limit climate change.

Source: KNMI, Klimaatverandering in de regio Amsterdam, April 2018



21 tropical nights per year (in 2050), compared to 7 nights now

Demand for energy increases
Shortage of electricity and heat

Fewer frosts

Sea level rises by 85 cm this century

Amsterdam is a fantastic city in which to live and work, and we want it to remain so. A healthy, thriving, green and future-proof city for all. We want Amsterdam to be a climate-neutral city with a circular economy, where energy is used efficiently and generated sustainably, and where raw and other materials are reused in a never-ending cycle. We also want Amsterdam to be a city that can cope effectively with the effects of climate change, such as flooding, increasing periods of drought and heat, and changing biodiversity. We have to change, so that everything we consider so important can remain the same.

1.2

Vision of a climate-neutral Amsterdam in 2050

What do we want to achieve?

To make a real contribution to meeting the Paris climate targets, we want to reduce Amsterdam's CO_2 emissions by 55% in 2030 and by 95% in 2050, compared to the reference year of 1990. We aim to phase out natural gas by 2040, and want to end all carbon emissions from transport by 2030. We also want the municipality to be a climate-neutral organisation by 2030. We will halve our use of new raw materials by 2030, and we want to have a 100% circular economy by 2050. We will phase out fossil fuels such as oil, natural gas and coal, and switch to 100% sustainably-generated energy. We will also become 'climate adaptive': design the city such that we can handle the inevitable consequences of climate change effectively.

In our vision, these ambitions will only have a chance of succeeding if:

1. We view the energy transition as a broad social transformation;
2. We adopt climate justice as a guiding principle;
3. We work together;
4. We as the municipality take the lead;
5. We take our responsibility as a capital city.

1 The energy transition requires a social transformation

The most radical operation since the industrial revolution

The transition to becoming a climate-neutral city is a massive challenge, and probably the most radical operation since the industrial revolution. It will require a broad social transformation, which will have an impact on our economy and daily lives. It will require a fundamental and structural transformation of our thinking and actions, but also a new distribution of property and ownership. It will have consequences for how we design our space, build, spend our money, generate and use heat and electricity, move around, reuse materials, and how we train our (future) labour force and help people to find work.

Moreover, the transition to a world in which we use only clean energy will not happen in isolation. It forms part of a broader global development into an ecologically, economically and socially sustainable society. Amsterdam has endorsed the UN's Sustainable Development Goals (SDGs), which link together seventeen global challenges with the aim of ending poverty, inequality and climate change. Amsterdam's vision of sustainable urban development draws on the concept of the 'doughnut economy' (Kate Raworth, *Doughnut Economics*, 2017). According to this model, an economy can only be sustainable and prosperous if social goals are achieved without exceeding the ecological ceiling.

Large and rapid changes such as these sometimes raise concerns. How much will I have to pay for energy? Will I still be able to drive my car in the city? Are there going

to be wind turbines in or around the city? How will I heat my house in future? Is my job going to disappear shortly? How can I keep my business going? There are many uncertainties, and we do not always know the answers. We have to let go of the old, though we are still often unsure of the new. The transition will be tough at times, not least because choices will need to be made that will not always suit everyone. We will do everything we can to ensure that this major change takes place fairly.

2 Climate justice is a guiding principle

Greenhouse gas emissions are leading to a decline in the quality of life around the world. People in the poorest countries, mainly in rural areas, contribute the least to global warming, but they are the most affected. They are the least well equipped to arm themselves against the negative effects of climate change, and have little voice or responsibility in policy-making. That is also true for our children and the generations to come. They lack a voice and have not contributed to climate change, but they will have to live with all the consequences. And this means that the climate problem is a justice problem.

In our city, too, the consequences of the energy transition will not be equal for everyone. Some residents or neighbourhoods are more vulnerable or will benefit less from the opportunities brought by the energy transition. The municipality wants to ensure that the transition from fossil fuels to renewable energy takes place fairly. The key principle is that living expenses for households with low or middle incomes should not rise due to the costs of the energy transition. Climate justice forms the guiding principle. We are aiming for a fair distribution of the costs and benefits, open access to the decision-making process, and equal opportunities in a changing job market.

We will apply this principle when implementing the Roadmap, and when evaluating and assessing our own actions. In section 4.2, under pillar 18, 'Working towards a fair energy transition', we explain how we are going to do this.

Some residents or neighbourhoods are more vulnerable or will benefit less from the opportunities brought by the energy transition

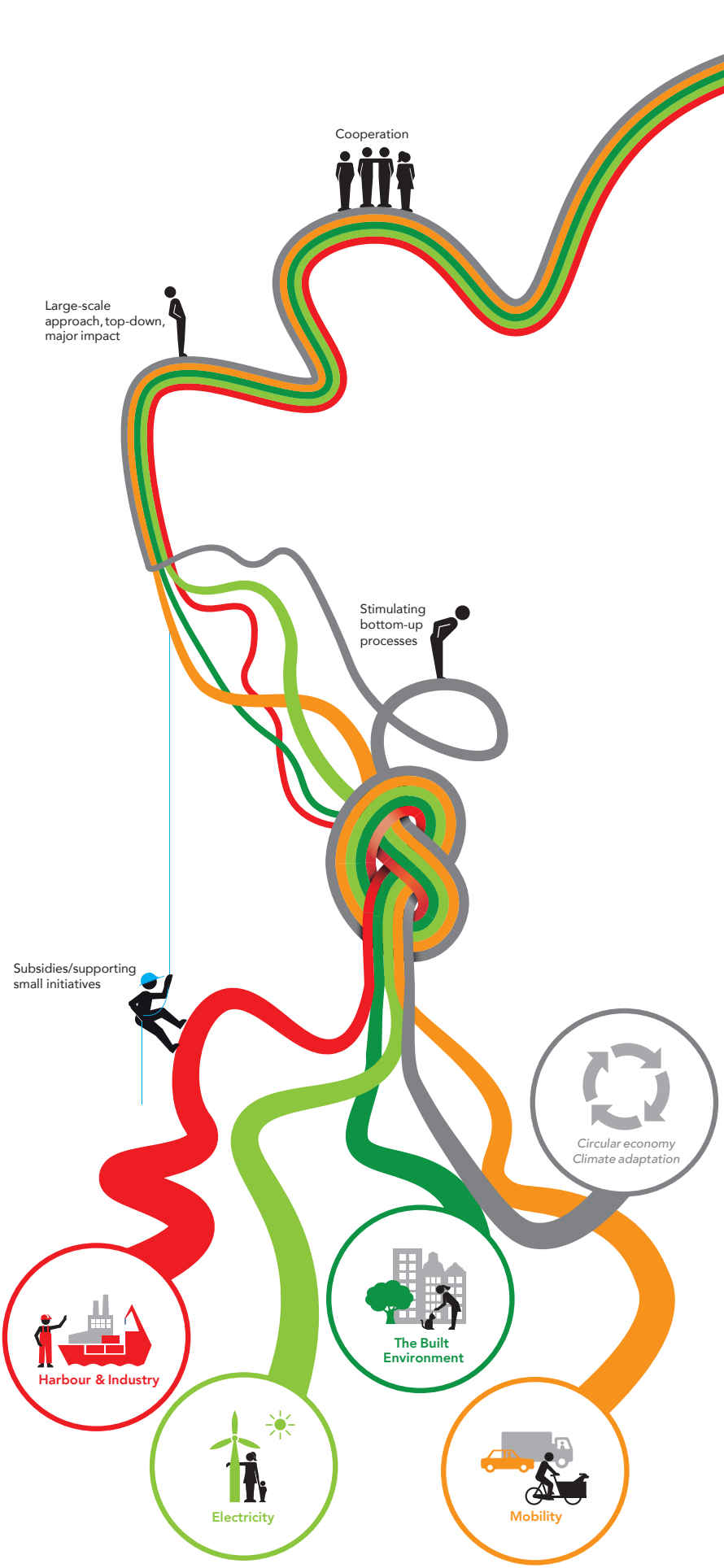
3 We work together

Neither the municipality nor any individual party can make the difference alone. We all bear responsibility, and we are deeply dependent on one another to meet the targets. Along with many citizens, the Municipality of Amsterdam has been working for years to save energy and generate clean energy.

But we need to accelerate our efforts; and based on our experiences in recent years, we think this can be done. We will accelerate in partnership with residents, companies and institutions in Amsterdam, but also with the region, the province, central government and Europe (see textbox on context, page 24).

The energy transition is a journey

The infographic shows the journey taken by the energy transition. We know that our city needs to become climate-neutral, and that this requires change; but we do not know what the journey to the final destination will be like, or exactly what our city will be like in 2050. We do know for sure that the journey will be long and winding. Various paths will be taken. Sometimes the paths will become entangled, due to large interdependencies in spatial planning, time, money, materials and labour, and sometimes interests will conflict. The proposals we are making now may be implemented in unexpected ways. New initiatives will be launched along the way. Particularly in the beginning, we will need to experiment and try things. This may work well, but it may not always have the expected impact. The municipality will mark clear milestones along the way, to guide our own ambitions and those of our partners. By doing and learning, the transition will increasingly converge. The only way to do this is to do it together. By taking the lead as the municipality, providing oversight and insight, and creating synergy, we will achieve our goals together.



2050

2050
- All buildings in the city carbon-neutral
- Harbour & Industry climate-neutral and circular

2040

2040
- All districts in Amsterdam natural gas-free

2030

2030
- 50 MW extra wind energy generated
- Half of all suitable rooftops fitted with solar panels: 550 MW
- Municipal organisation climate-neutral
- Amsterdam's transport emissions-free
- Energy label A for offices

2025

2025
- All permits issued for new wind turbines
- Realisation of carbon capture system at AEB

2024
- Realisation of 100 MW electrolysis plant H2ermes, Tata Steel

2023
- Corporations' carbon emissions reduced, from 1.5% in 2019 to 3% in 2023

2022

2022
- 3 districts/12 neighbourhoods in irreversible process to become natural gas-free

2020
- Tightening of national legislation on almost-energy-neutral buildings (BENG)
- 'Year of the Sun'
- New strategy for a sustainable harbour
- First 29 GVB buses emissions-free

We see that residents, companies and institutions have a great capacity for self-organisation. With this Roadmap, the conversation with the city and the New Amsterdam Climate platform, we are supporting the citizens and companies playing a leading role in the movement towards a climate-neutral city. Together with our partners, we are identifying opportunities and encouraging others to take them. Wherever desirable, necessary and possible, we provide expertise, skills and financial resources. See also pillar 17 on 'Building the movement in the city'.

At the same time, we see that not everyone is able or willing to take part. We need government coordination and management to meet the targets.

4 The municipality takes the lead

We see managing the journey to become a climate-neutral city as our most important task. Without stimulation, governance, regulation from above and firm agreements with the major players, we will not meet our CO_2 targets.

We see it as our task to set clear public goals for the city as a whole. What do we want to achieve, and what are the key steps along the way? With this Roadmap and future updates, we offer insight into the process and how it is monitored. For those parts of the challenge for which we are responsible, we set targets on which we can be held to account; such as making the municipality more sustainable, for example. When collective solutions are needed, we will take the lead; such as when building a city-wide heat distribution grid. We expect other parties to rise to the challenge, too, and we will support them as much as we can.

If other parties fail to act or do too little, we will ultimately turn to regulations, or we will urge central government and the province to introduce more binding legislation and regulations. The municipality and other governmental authorities will ensure compliance with these. Leadership also means launching and maintaining effective partnerships between governmental authorities, private sector parties, civil society organisations and residents. We will organise discussions and bring parties together, providing direction and coherence.

We all bear responsibility, and we are deeply dependent on one another to achieve our goals

5 We are a responsible capital city

Global warming has consequences for societies around the world. The more extreme weather conditions caused by climate change are increasingly leading to human disasters. Changing weather patterns have a profound effect on agriculture, forests, fisheries and cattle farming, leaving many people short of food. Having fallen for years, hunger is rising again around the world, primarily as a result of climate change.

As one of the most affluent cities on earth and the Dutch capital, Amsterdam is responsible for making a real contribution to the transition to a more sustainable world. And in doing so, we have winning cards in our hand. Amsterdam is a compact and densely built-city, with significant social support and many opportunities for efficient and sustainable collective solutions. Amsterdam is also a smart and creative city, with a deeply-rooted mercantile spirit. The city has a high density of knowledge-oriented companies and institutions, making it a breeding ground for innovation. Thanks to this unique combination of creativity, innovation and entrepreneurship, Amsterdam is a city that can handle major change. Amsterdam will also thrive in the future if we can all work together – residents and businesses – to manage our precious resources as efficiently as possible, and to create new, sustainable products to meet the growing demand for sustainable solutions.

Project in the spotlight

Local farmers cut carbon emissions

"Agriculture is one of the causes of carbon emissions, both in terms of production and in terms of transport", says Ron van Echteld, initiator of the NoordOogst foundation. "Local, small-scale organic farming with smaller herds is much better for the environment."

NoordOogst is an urban agricultural project located on a former football field on Meteorenweg, Amsterdam-Noord. It features allotments, a forest garden, a beer brewery, a pig farm and other food-related sustainable activities. Ron: "With a vegetable subscription, people can harvest their own food. Everything is circular: waste products and organic waste are made into compost, processed or fed to the pigs."

"I think it's strange that food isn't automatically included in the transition path," says Ron. "Transporting food emits CO_2, among other things. Our butcher is as local as possible, and our vegetarian catering firm delivers everything by cargo bike. The municipality has commissioned NoordOogst and Stadslandbouw Nederland to develop a social exchange, which will allow us to measure the impact of projects such as ours."

"In addition, the municipality is working on a food strategy. All urban farmers in Amsterdam, the Food Council and other parties will draw up a manifesto on this and present it to the alderperson."

"I'm not opposed to eating meat, but we can't go on keeping cattle like this in the Netherlands! Our pigs have space and a very good life. With this ratio – twenty pigs to half a football field – you don't need to spread any manure, which improves the quality of the soil organically."

According to Ron, local agriculture is possible across the Netherlands. "With the 'gentlemen farmers' concept, five hundred families pay for a single farmer. The farmer keeps pigs, cows and chickens, and grows vegetables and fruit. You need 20 hectares for five hundred families. In the Netherlands, we have more than enough agricultural land to feed 17 million people this way."

The Roadmap in a broader context

In December 2015, 197 countries, including the Netherlands, marked a historic moment by signing the Paris Climate Agreement. The Agreement set an upper limit of 2 degrees of global warming, and the signatories aim to limit warming to 1.5 degrees. In order to achieve this, measures need to be taken that range from the global level to that of the individual.

Green New Deal

In early 2020, the President of the European Commission, Ursula von der Leyen, and Commissioner Frans Timmermans presented the Green New Deal to make Europe the world's first climate-neutral continent by 2050. The proposed measures range from renovating millions of homes to planting 2 billion trees. The European Commission wants to enshrine the measures in a European Climate Law. Timmermans emphasises the major role played by cities in the transition to a sustainable world; covering just 2% of the earth's surface, they are home to more than half the world's population and responsible for 75% of all greenhouse gas emissions (source: the UN). By 2050, two -thirds of the world's population will live in cities. Amsterdam is also growing rapidly; by around 2030, we will be a city with a million residents.

The Dutch Climate Agreement

The Dutch Climate Law sets national targets for cutting greenhouse gas emissions: 49% fewer CO_2 emissions in 2030 and 95% fewer in 2050, compared to 1990. In order to achieve this goal, the National Climate Agreement was presented in June 2019. The Climate Agreement is a key part of implementing the Paris Agreement in the Netherlands. The agreement contains more than 600 agreements between businesses, civil society organisations and governmental authorities, with the aim of collectively halving greenhouse gases emissions by 2030, compared to 1990. Several ministries are responsible for implementing the agreement. The Climate Agreement has been endorsed by the Municipality of Amsterdam. In addition, the Dutch State has set the target of reducing greenhouse gas emissions by at least 25% by the end of 2020, compared to 1990. In 2015, the courts ruled in the Urgenda climate case that the Dutch State had to adhere to this target.

Regional Energy Strategy (RES)

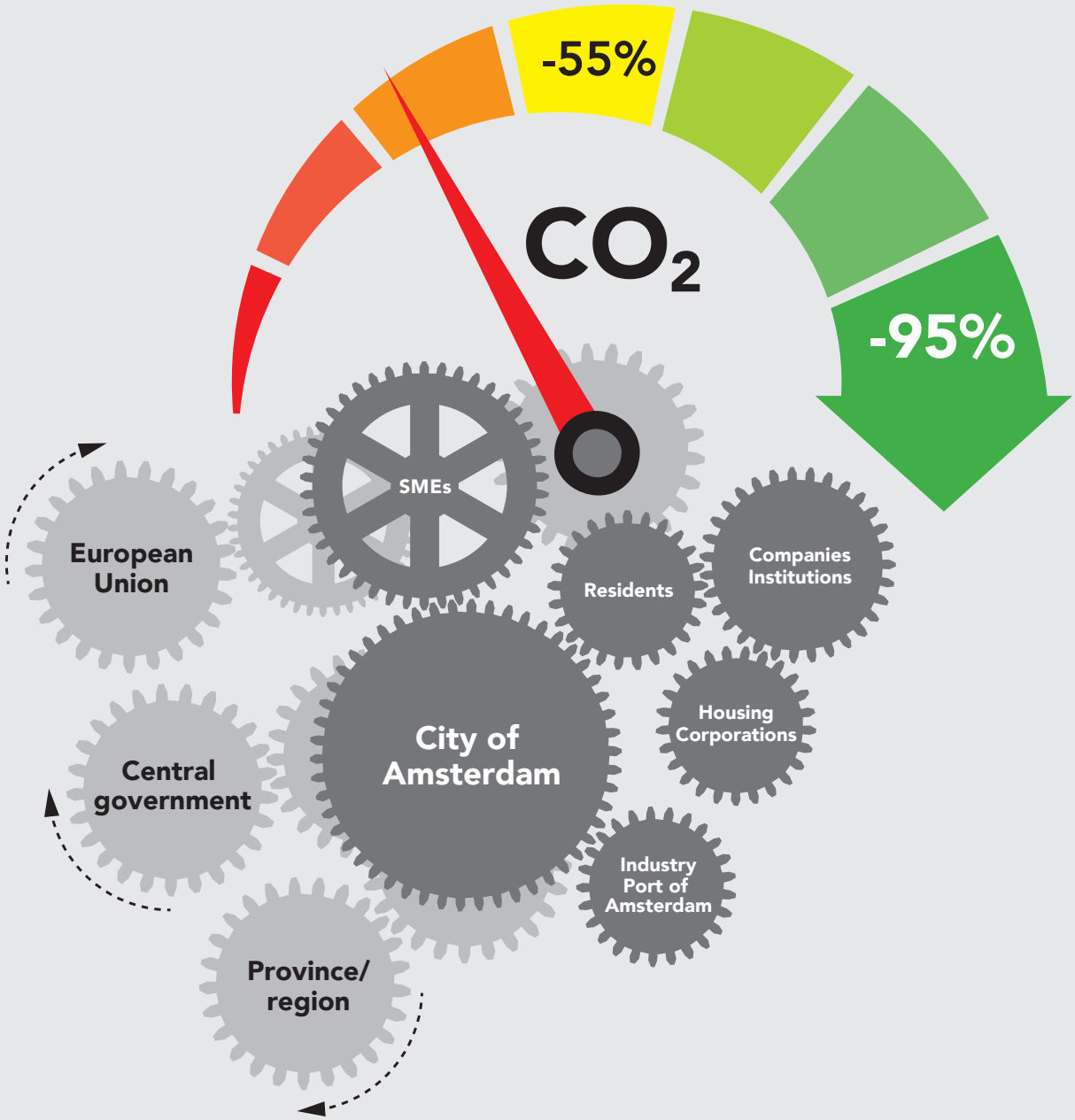
The national agreements on the generation of renewable energy are developed in thirty Regional Energy Strategies (RESs). Amsterdam cooperates with seven other sub-regions in the RES region of Noord Holland Zuid. Each sub-region investigates demand for heat and electricity, and indicates how much sustainable heat and electricity can be generated on its territory. Amsterdam's RES provides insight into where solar panels and wind turbines could be installed in the city, and how much electricity this would generate. This information is also included in this Roadmap.

Regional cooperation

Amsterdam is also seeking to cooperate regionally with other authorities and private actors on additional themes, such as when establishing datacentres and the ongoing development of regional energy systems. In the Energy Programme run by the North Sea Canal Area platform, regional parties are working together to develop the necessary energy infrastructure, for example. We will also establish a regional heat strategy (*Regionale Structuur Warmte*), which will describe demand for heat, the available heat supply, the necessary infrastructure, and potential heat distribution bases. In addition, all cities in the Netherlands have to produce a vision document on the heating transition (*Transitievisie Warmte*). This sets out timeframes for phasing out natural gas in neighbourhoods and the most feasible 'preferred' alternative form of heating. Amsterdam is cooperating with partners from the Amsterdam Metropolitan Area (Metropoolregio Amsterdam, MRA) and the Amsterdam Transport Authority (Vervoerregio Amsterdam, VRA) on a Regional Mobility Plan, which also builds on the National Climate Agreement.

The Spatial Vision and the Spatial Plan

Amsterdam's new Spatial Vision outlines a vision of the city in 2050, and sets the course for the future. The Amsterdam Climate Neutral Roadmap, the Regional Energy Strategy and the *Transitievisie Warmte* all serve as input for this. The Spatial Vision provides guidance and key principles for the spatial translation of the energy transition. The Spatial Plan then provides opportunities for facilitating or regulating activities that contribute to the energy transition.



No one can achieve the energy transition alone

The city's transformation from dependence on fossil fuels to using 100% sustainable energy from renewable sources will involve an interplay of different parties, which must cooperate in order to move in the right direction. It can be visualised as a mechanism with many 'cogwheels'. Amsterdam's entrepreneurs and residents are the driving force behind the transition to a sustainable city, but they cannot do it alone. An individual resident can decide to use LED lighting at home, but they cannot build a new heat distribution grid. A company can sell climate-neutral products, but they will not succeed if there is no market for them. It is the government's job to create the right conditions for action. At a certain point, everyone will become involved in this challenge, and everyone has a part to play: residents, entrepreneurs, companies, corporations, research institutes, school boards and catering companies, as well as neighbouring municipalities, the province and central government. Only by cooperating can we provide direction and make rapid progress on the path to a climate-neutral Amsterdam by 2050.

1.3

Strategy

In the previous chapter, we described our vision of a climate-neutral Amsterdam in 2050. But how will we get there? How can we ensure that the energy transition is launched and maintained?

Five aspects of our strategy are crucially important:

1. We work substantively with four transition paths and twenty pillars;
2. We play different roles that will change over time;
3. We focus our efforts and resources;
4. We work systematically and cyclically;
5. We work from the top down and from the bottom up.

1 We work substantively with four transition paths and twenty pillars

Similar to the national system, we identify four transition paths that the transformation will take to a climate-neutral city: Built Environment, Mobility, Electricity and Harbour & Industry (see chapter 3 on 'Transition paths'). Built Environment is about disconnecting existing buildings from the natural gas grid and building energy-neutral new-build homes and offices, as well as the city's schools and hospitals. Mobility concerns the transition to a system in which people and goods can be transported without emitting CO_2. The Electricity transition path is about generating renewable electricity and building a reliable electricity infrastructure. Harbour & Industry concerns the transition to a sustainable industrial cluster that will supply Amsterdam and other regions with renewable energy.

Because we believe that the municipality should set a good example, we are also working on becoming a sustainable organisation. This means making our internal operational management climate-neutral, including our transport fleet and property. It also concerns everything we purchase, including the materials that we use to organise public space, and the behaviour of our staff. Our aims are set out in the municipal action plan on sustainability (*Uitvoeringsagenda Duurzame Organisatie 2020-2030*).

In each of the four chapters on the transition paths, we describe the actions we will take to cut CO_2 emissions in a number of pillars, sixteen in total. In another four pillars, we describe measures that will not lead directly to less CO_2, but that will play a crucial role in the transition from fossil to renewable energy: pillar 17 on building the movement, pillar 18 on climate justice, pillar 19 on knowledge development and innovation, and pillar 20 on space and the energy infrastructure (see chapter 4, 'What needs to be done?').

2 We play different roles that will change over time

In order to be able to achieve this transition, the municipality will play different roles in the process. These roles will change over time. In chapter 3, we describe the roles we want to play in each transition path. These will depend, among other things, on the municipality's position relative to other actors and the current phase of the transition. Based on the model developed by the Dutch School for Public Administration, we have identified four roles for the municipality: presenting,

In the Climate Budget, we provide insight into the challenge and the effects of the measures

regulating, cooperating and supporting (Dutch School for Public Administration, *Sturen en stromen*, 2017).

The performing municipality

As a performing municipality, we ensure that public tasks are undertaken properly: that public space is sustainable, clean, intact and safe, for example; that our city remains accessible when the streets are dug up to lay new electricity and heat infrastructure, or the approaches to quays and bridges; that the long-term unemployed are helped to find jobs, if possible with companies that install solar panels or cables and pipes; and that we take account of the installation of wind turbines or solar panels when planning the city. The instruments that we have for this include land allocation, tendering, purchasing, contract management, municipal service delivery, financing, monitoring and effect measurement.

In addition, the municipality is also an employer, owner/landlord of buildings and facilities, a large procurement client and the owner of an extensive transport fleet. The municipality wants climate-neutral working to become the new normal. We have set ourselves the target of becoming a climate-neutral organisation by 2030 at the latest, and will carry out all our public tasks in a sustainable way.

The regulating municipality

As a regulating municipality, we focus on legitimacy and legality. We provide procedures and anchor targets and resources in legislation and rules. Our instruments include regulation, permits, enforcement, policy frameworks, policy plans, subsidies, legislation and legal procedures (objections and appeals).

This includes legislation that compels owners of commercial property with high electricity consumption to take energy-saving measures, the lawful dispensation of public funds by developing and implementing subsidy regulations, and the spending of resources from the Climate Fund. It also includes implementing the Environment and Planning Act, Spatial Vision and spatial plans. For this, we work closely with the Regional Agency for the Environment, which is tasked by the province or municipality to issue permits to businesses and enforce them where necessary.

We will update the Roadmap every year

The cooperating municipality

As a cooperating municipality, we focus on working with residents, businesses and institutions to achieve common goals. This means that every party must have something to gain and something to contribute; every partner plays their part. Shared ambitions develop gradually, taking time and effort, but this delivers a result that adds up to more than the sum of the parts, and that can count on support and implementation. Instruments include cooperative platforms, agreements, covenants and declarations of intent, whereby knowledge, skills and resources are shared. Within the City Deal for a gas-free future, the municipality, corporations, WestPoort-Warmte, Waternet, tenants and grid operators cooperate in this way, because these parties are dependent on one another to achieve the common goal of phasing out natural gas.

The supporting municipality

As a supporting municipality, we assume that residents, owner-occupier associations, companies and institutes have the capacity to self-regulate and self-organise. Wherever possible, the municipality provides support in the form of knowledge, skills and resources. The instruments we use include subsidies, advice and information, facilitation of knowledge-sharing, the establishment of help-desks to support initiators, simplifying guidance on procedures and rules, lobbying and communication. For example, the municipality took the initiative to launch the New Amsterdam Climate platform, which now showcases more than 200 sustainable initiatives in Amsterdam. With this online platform, we want to inspire all citizens and provide

an opportunity to showcase their efforts, share expertise and find support. The platform offers practical assistance, such as guidance on subsidies and loans, energy coaches, knowledge and tools to establish and implement projects.

It is important to be clear about the role that the municipality plays in the process. This will make cooperation transparent and government a reliable partner.

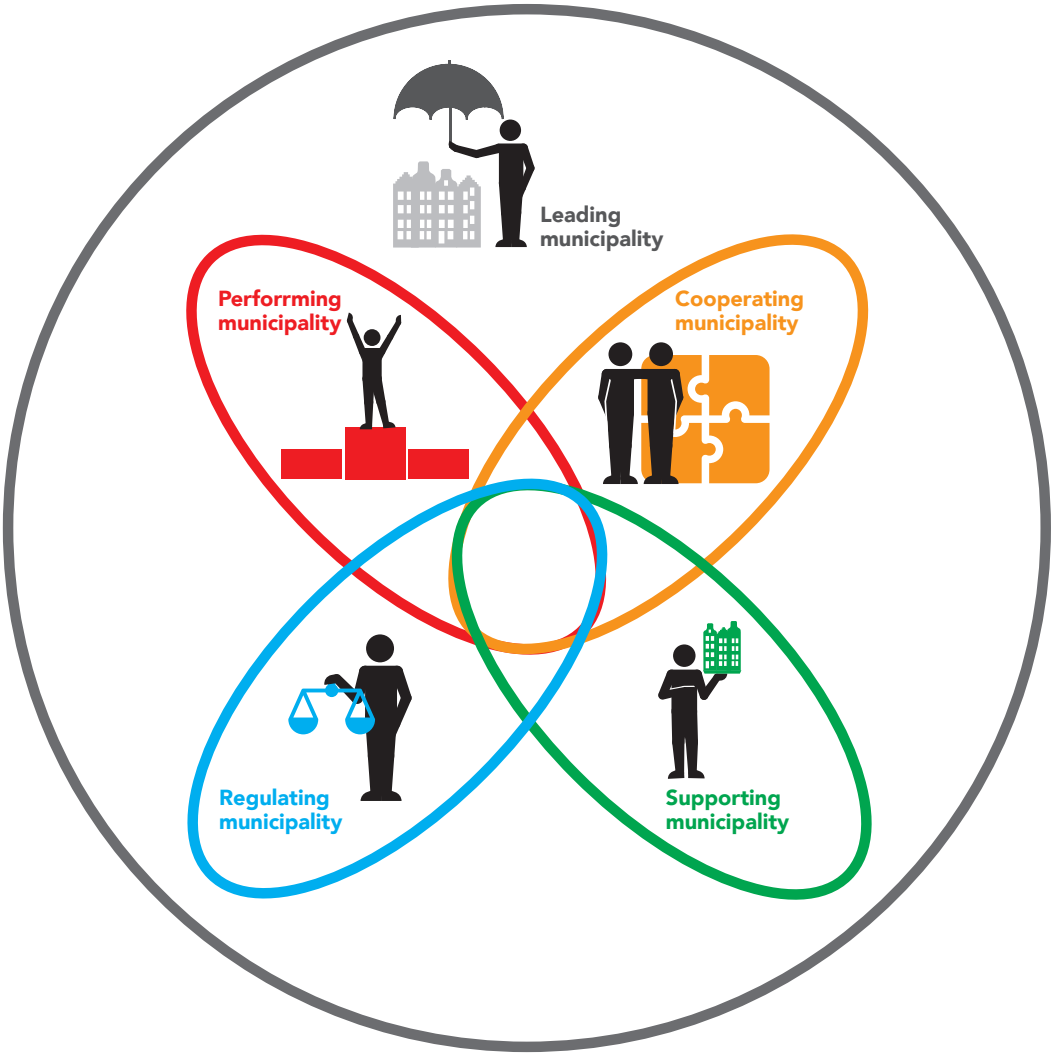
3 We focus our efforts and resources

The role that we play in each transition path and the impact we can have partly determine the commitments that we make and the quantity of resources we deploy, such as from the Climate Fund. In view of all the other parties – such as governmental authorities, businesses, organisations, residents – where can we have the greatest added value?

This means that for each of the transition paths, we also need to understand the nature of the challenge, the size of the investment and savings, and any inevitable

The municipality will play the largest role in the Built Environment transition path

Municipal roles



losses. And this is made-to-measure work.

The municipality plays the largest role in the Built Environment transition path. Phasing out natural gas in the city and making the necessary energy savings in all homes and buildings requires municipal leadership and resources. This also means that we will use the majority of the Climate Fund to launch the transition in the built environment. We will subsidise the unprofitable part of the business cases of homeowners, including corporations and owner-occupiers, who want to tackle their homes. With partners, we are also investing in the infrastructure projects that will be needed to phase out natural gas in Amsterdam. Although the municipality is investing heavily, we will only be able to disconnect from natural gas if central government introduces tough regulations and investment funds.

In the other transition paths, we will play roles that lead to a more limited use of capacity and resources, often because other parties play larger roles here. For example, the investment climate in the Harbour & Industry transition path is very strongly determined by the international market and national legislation and financial instruments, such as carbon and energy taxes and national subsidies. The municipality can play a role in providing the new infrastructure that will be needed. For mobility, we expect the transition to be relatively rapid, due to innovation and developments in the private sector. We will regulate these developments with environmental zones, for example, or stimulate them with subsidies. Here, too, we will create the preconditions for development by establishing the necessary infrastructure. Aside from the spatial issue and adaptation of the electricity grid, the developments in the Electricity transition path will be highly dependent on national regulations, provincial policies and subsidies.

If we are clear and transparent about our focus, companies and residents will know what they need to do and which investments they can make.

Residents, entrepreneurs and institutions that want to get started on the transition can count on support from the municipality

4 We work systematically and cyclically

Some measures that are described in this Roadmap have a direct impact on carbon emissions, but others have an indirect impact. Some measures will work immediately, others later. Sometimes the impact will be large, other times small. How can we determine whether we are on the right track? And how can we adjust in a timely way if we risk failing to meet our targets? To manage this, we will work cyclically and run through three steps systematically every year.

Step 1: Implementing actions and measures

Amsterdam is constantly undertaking actions and measures to achieve our climate-neutral ambitions. In the first place, these include measures to reduce carbon emissions in the city, but we are also taking actions that are crucial for the energy transition in other ways. These include boosting support in the city, encouraging innovation, and supporting small initiatives.

Step 2: The Climate Budget

We work with a Climate Budget, the quantitative part of the Roadmap. On the one hand, this provides insight into the challenge, and on other hand, it gives insight into the effects of the measures we are taking.

In the Roadmap, we have mapped out Amsterdam's total carbon emissions in detail. We now know where the emissions are coming from for each transition path, portfolio or target group. We have also mapped out other relevant aspects of the challenge, such as support and energy poverty. In addition, we have calculated the expected effects of all of the actions and measures in this Roadmap on the reduction of carbon emissions by 2030. Due to uncertainty, we use a range when making the calculations. The full content of the Climate Budget is addressed in chapter 2 of the Roadmap.

Step 3: Adjust

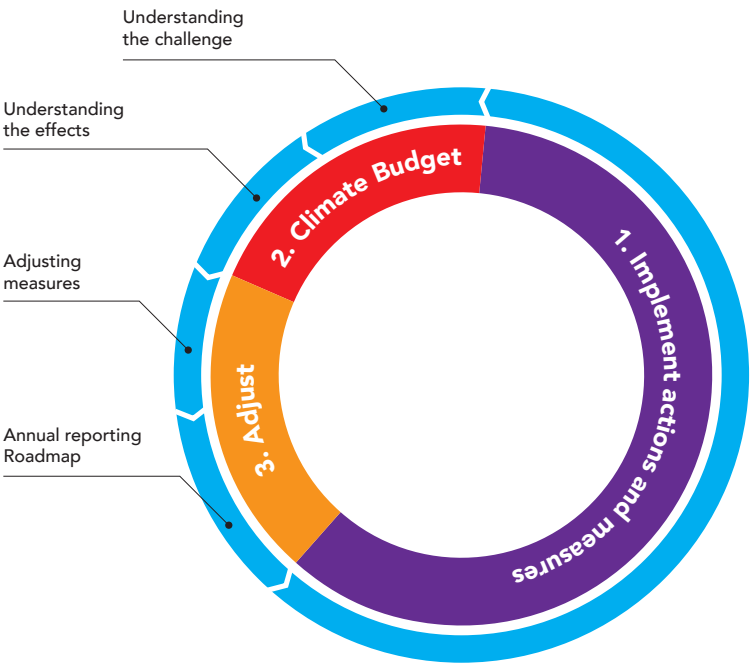
Based on insights from the Climate Budget, Amsterdam will manage the process by adapting measures or launching new activities. That way, we can always ensure that we have enough promising measures 'in the pipeline' to allow us to achieve our ambitions.

Each year, we will publish a report that gives an overview of the adjusted measures. The report will also contain the annual update on the Climate Budget, in which we both reflect on the past and look to the future: what progress has been made towards the targets, and will we meet them as expected?

By following the three steps described above, we have a thorough system in place for monitoring progress, estimating the impact of the measures taken and, based on this, making choices or setting priorities.

We take a dual approach to becoming a climate-neutral city: from the top down and from the bottom up

The annual steering cycle in three steps



5 We work from the top down and from the bottom up

The municipality is taking a dual approach towards becoming a climate-neutral city: from the top down and from the bottom up. When necessary, we work from the top down, not least because this is required by central government. In this case, we take the lead and work systematically to achieve our targets. In doing so, of course, we also work with residents, companies and institutions. To keep costs down and work quickly, we take a uniform approach whenever we can. The vision document on the heating transition (*Transitievisie Warmte*) is one example of this. Taking a systematic, district-by-district approach, this document describes where and when districts will disconnect from the natural gas grid, and the preferred alternative sustainable heating source in each case. The municipality and its partners make a proposal that is discussed at length with residents, companies and institutions, and then agreed at the administrative level. The *Transitievisie Warmte* subsequently forms the basis for the large-scale operation to disconnect districts from natural gas.

The strength of such a transition lies in the combination of these kinds of top-down, collective decisions with the contribution of thousands of citizens who are taking action individually. We are also highly dependent on these smaller initiatives and projects. As a municipality, we support frontrunners in their efforts to help make the city climate-neutral. The experience that we gain can help us to improve our policies, regulations and procedures. In this way, we also learn where collective solutions are needed. We call this 'building the movement in the city', and it is described in more detail in chapter 4, under pillar 17.

Project in the spotlight

Cutting energy bills by insulating curtains

In Gaasperdam, fifteen women from Ghana, the Dominican Republic and other countries meet each week to sew insulation curtains. The curtains help poorer families to cut their energy bills.

"These women find it difficult to integrate into society", explains Diny Ceelen (Cocratos foundation). "Thanks to this project, we can record their skills in a certificate, which will soon give them more opportunities in the job market. The women's prospects improve, and at the same time, backing the curtains with insulating material helps to reduce energy consumption."

The project forms part of a larger plan, explains Diny. "There are currently plans and negotiations underway for heat distribution grids, but the residents are not sufficiently aware of this. It is better to investigate all of the options with the residents, so that they're able to weigh them up properly. In Gaasperdam, the residents want to produce green gas: sewage waste with vegetable, fruit and foodstuffs, fermented into gas. Combined with solar panels and a hybrid heat pump, you get a system without having to dig up the ground."

It will take a while for the housing corporation to insulate people's homes. Diny: "That's why we've opted for a quick fix in the meantime: we're teaching people how to install insulating foil, giving workshops on applying foil and filling cracks. Or we're training them to take thermal images, to see where a home is losing heat. This creates job opportunities and the district is becoming more sustainable; it's the first Doughnut Deal."

The energy transition will only succeed if there is cooperation with residents, says Diny. "Because it's the residents who will ultimately see the difference in costs. You can increase the tax on gas, but many people don't have any influence on gas consumption – they don't have access to the boiler, for example – yet they still have to pay. Financial incentives like that can work the wrong way; certainly in this neighbourhood, where 54% live on or under the poverty line. In my opinion, we should focus more on the concept of 'energy justice'. If not, we'll create our own yellow vest movement."

Shanice van der Sloot

Founder of Water to Grow

"It's clear that the climate is changing. You can look at how companies, the municipality and the authorities are addressing sustainability, but I don't have any influence on that. So I'm starting at home. After all, you make choices every day. It starts when you get up and have breakfast. From what you eat and how you get to work, to what you do or don't buy. I've noticed that I'm influencing the people around me, too, and that's great to see."

"Twice a year, we organise a clothes swap with a group of friends. Everyone brings some clothes with them. You take what you like and give the rest to a second-hand shop. It's a simple thing to do, but it gets you involved in sustainability in such a fun, accessible way that you're hardly aware of it. With such activities, I'm keen to involve people who don't normally think about sustainability."

"I like to do fun and simple things to involve others in sustainability – like organising clothes swaps, for example."

"At home, the previous owners had already put aluminium foil behind the radiators. I rarely use the heating; usually, I simply wear an extra sweater. Other things, like switching off the lights when you leave a room, are standard for me. Also taking short showers, so you don't use too much water. That saves money, too."

Chapter 2

The Climate Budget

The Climate Budget is the quantitative part of the Roadmap. This chapter on the Climate Budget addresses the emissions for which Amsterdam is responsible; these amount to 5,000 kt of CO_2 every year. We provide insight into the figures and the quantitative effects of all the planned actions and measures in the Roadmap. This is done for each transition path and also, when possible, at portfolio level. Combined with autonomous developments, the specific package of actions and measures in the Roadmap is expected to result in a 48% drop in CO_2 emissions in Amsterdam by 2030. The calculation has a range of between -21% and -55%, meaning that a reduction of 55% lies within reach.

2.1

Understanding the challenge

We have a good picture of where carbon emissions are taking place in Amsterdam. This is information that the city needs in order to take and manage CO_2-reducing measures. By providing insight into the data, we have laid solid foundations that we can build on in the coming years.

Greenhouse gas emissions

In 2017, 5,000 kilotons (kt) of CO_2 equivalents were emitted in Amsterdam. The quantity of greenhouse gases emitted in Amsterdam is the key indicator used in the Roadmap. At the time of publishing, 2017 was the most recent year for which a full picture of all greenhouse gas emissions in Amsterdam was available. Greenhouse gases other than CO_2 that also contribute to global warming have been converted into CO_2 equivalents and included in the figures. For simplicity's sake, we only refer to CO_2 emissions in the Roadmap. In 1990, 3,810 kt of CO_2 were emitted.

From 1990, due to the growth of the city (more residents, homes, jobs and tourists), emissions in Amsterdam rose to 5,510 kt in 2010. Since 2010, emissions have fallen again. This is an achievement, given that the city grew rapidly in the same period. This fall in emissions is related to the increasing generation of renewable energy and the fall in energy consumption per resident. Today, total greenhouse gas emissions in the Netherlands are already lower than in 1990, but this is not yet the case for Amsterdam. The city's emissions are still falling too slowly. In order to achieve our carbon ambitions, we will need to reverse this trend. The expected further growth of the city will pose an additional challenge for Amsterdam.

When presenting the figures, we sought advice from the National Climate Monitor, Statistics Netherlands, the PBL Netherlands Environmental Assessment Agency, the Netherlands National Institute for Public Health and the Environment, the Province of Noord-Holland, the Association of Netherlands Municipalities, the Port of Amsterdam, AEB Amsterdam and CE Delft consultants. As a result, this Roadmap presents a more substantiated and fairer picture than the *Amsterdam Climate Neutral Roadmap 2050: An invitation to the city* (February 2019). It turns out that an even higher reduction in carbon emissions will be needed in 2030 (3,290 kt compared to 3,200 kt) if we are to achieve our ambitions (a 55% fall in CO_2 emissions by 2030, compared to 1990). The data sources used to chart the emissions are described in the Technical Report on the *Amsterdam Climate Neutral Roadmap 2050.*

Carbon emissions are falling, while the city is growing

Emissions per transition path

The built environment in Amsterdam is responsible for 25% of the carbon emissions. This is primarily caused by the consumption of gas and heat by existing and new homes, commercial buildings, and social and civic buildings (such as offices, schools and hospitals). Mobility is responsible for 18% of CO_2 emissions in Amsterdam, mainly due to fuel consumption. We are aiming for a zero-emissions transport system, by having cleaner vehicles and less motorised transport. Electricity causes 39% of all CO_2 emissions; these are the emissions resulting from electricity consumption. This transition path also covers the generation of renewable electricity in Amsterdam and the development of a future-proof electricity infrastructure. The harbour and industry are responsible for 18% of the emissions; these are emissions produced by industries located in Amsterdam. This transition path also covers the development of a sustainable industrial cluster that will supply Amsterdam and other regions with renewable energy.

Total emissions
5.000 kton CO_2 equivalents

100%

Built Environment

25%

Natural gas and heat consumption and other greenhouse gasses

Housing
14%

Business market
7%

Social & civic buildings
4%

Mobility

18%

Fuel consumption

Roads in Amsterdam
9%

Motorways
6%

Mobile machinery
2%

Ferries, recreational boats and disel trains
0.2%

Other greenhouse gasses
0.6%

Electricity

39%

Electricity consumption

Business market
21%

Housing
8%

Social & civic buildings
6%

Industry
4%

Harbour & Industry

18%

Waste incineration
11%

Natural gas and heat consumption industry
5%

Fuel consumption inland shipping and fishing
0,5%

Other greenhouse gasses industry
1.5%

Breakdown of electricity consumption by business market sector, Amsterdam

Business market

21%

Sector

Information and communication
6%

Wholesale and retail trade
4%

Transport and storage
3%

Catering
3%

Financial activities
2%

Trade in real estate
1%

Professions
1%

Administrative service provision
1%

Agriculture and forestry
0.1%

Other indicators used

In addition to gaining insight into carbon emissions, we also want to monitor other aspects of the energy transition. We have defined various indicators, including corresponding target values, which the municipality will use to manage the transition. First, support for the energy transition and the corresponding measures. In 2019, 75% of Amsterdam's citizens supported the switch to renewable energy (source: Research, Information and Statistics (OIS) department, Municipality of Amsterdam). The municipality aims to maintain this level of support in the coming years. If there are fluctuations, we will investigate the causes.

According to research (OIS 2017), 11% of Amsterdam's households were affected by energy poverty in 2017. This means that almost 50,000 households in Amsterdam spent more than 10% of their income on energy. The share was 31% among low-income households (those eligible for housing benefit). Data will become available on the developments in the past two years in the course of 2020, and the ambition level will be developed in the coming year.

How Amsterdam's citizens feel about the transition to renewable energy (2019)

Positive
75%

Negative
9%

Neutral
14%

Don't know
3%

According to data from Liander and the national RES programme, the installed capacity for sustainable electricity in Amsterdam is 73 MW for solar energy (end of 2019) and 66 MW for wind energy (mid-2019). We aim to increase this to 550 MW for solar (400 MW of which on large roofs) and 127 MW for wind in 2030. These ambitions are also included in the Regional Energy Strategy (RES).

A full overview of the indicators is provided in the table below. Some of the indicators and target values will be developed further in 2020, and we will report on the outcome of this in the next annual report on the Roadmap (first half of 2021).

Indicator by transition path/subject	Starting point (and year)	Target values (and year)
Built Environment		
Total number of home equivalents natural gas-free (of existing buildings in Amsterdam in 2019)	91,000 (2019)	260,000 (2030)
Number of home equivalents for which the feasibility phase of the district-based gas phase-out programme (WAM) started in the given year	3,000 (2019)	5,000 (2020) 10,000 (2021) 15,000 (2022) 22,000 (2023) 29,000 (2024)
Number of home equivalents for which an investment decision has been taken to phase out natural gas (WAM) in the given year	1,700 (2019)	3,000 (2020) 5,000 (2021) 10,000 (2022) 15,000 (2023) 22,000 (2024)
Annual reduction in carbon emissions, housing corporation homes	1.5% (2019)	At least 3% (2023)

Indicator by transition path/subject	Starting point (and year)	Target values (and year)
Number of extra owner-occupier associations (VvEs) supported per year	N/A	300 VvEs, 11,000 homes (2020) 400 VvEs, 38,000 homes (2021)
Number of supporting companies	Unknown	Determine when establishing Business Market programme (Q4 2020)
Number of companies monitored by the Regional Agency for the Environment	976 planned (2017)	1,550 checks per year, focusing on energy theme
Number of social and civic buildings where energy measures are taken		To be developed in 2020 in sustainability programme social and civic buildings
% of permits issued for new buildings at least Energy-Neutral Building (ENG) level		To be developed in 2020
% of new-build tenders with minimum level ENG		To be developed in 2020
Mobility		
% of kilometres of motorised transport on Amsterdam's roads driven by electric vehicles	3.1% (2019)	95% (2030)
Number of public electric (rapid-) charging points in Amsterdam	3,300 (2019)	Not a target value, because municipality facilitates demand. Only follow development
Electricity		
Total installed capacity (in MW) of solar energy in Amsterdam	73 (end of 2019)	100 (2020) 150 (2021) 250 (2022) 350 (2023) 550 (2030)
Total installed capacity (in MW) of wind energy in Amsterdam	66 (mid-2019)	77 (2021) 127 (2030)
Total number of land allocations (tenders and one-on-one permits) for wind turbines in Amsterdam	N/A	4 (2020) 6 (2021) 8 (2022) 10 (2023)
Harbour & Industry		
Indicators to be developed in more detail in 2020 with drafting of the Harbour Strategy 2021-2025		To be developed in 2020

Indicator by transition path/subject	Starting point (and year)	Target values (and year)
Support		
Share of Amsterdam's citizens who support the switch to renewable energy	75% (2019)	75% (2020-2023)
Climate justice		
% of low-income households in Amsterdam (eligible for housing benefit) whereby more than 10% of household income is spent on energy	31% (2017)	Not a target value, as municipality has limited influence. Only follow development
Total number of energy consultations by energy coaches	N/A	16,000 (period 2016-2020)
Spatial impact		
Indicator to be developed further in 2020		
Energy infrastructure		
Indicator to be developed further in 2020		

Data on energy consumption in Amsterdam (consumption of natural gas, heat and electricity) will be addressed for each transition path in chapter 3.

Which emissions is Amsterdam responsible for?

In order to determine which carbon emissions Amsterdam is responsible for, we follow the framework in the National Climate Law. This framework is based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and the EU's Monitoring Mechanism Regulation of 2013. The IPCC guidelines also formed the starting point for the Paris Agreement. In line with this framework, we take account of emissions of all greenhouse gases (such as CO_2, methane and nitrous oxide), with the exception of emissions caused by international shipping and aviation, the incineration of biomass and the biogenic part of waste, and emissions released by the oxidation of peatlands. Energy consumption by international shipping is not counted in the protocol for monitoring the EU's Renewable Energy Directive, either.

To allocate national emissions at the municipal level, Amsterdam uses the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). Derived from the international Greenhouse Gas (GHG) protocol, this protocol identifies three 'scopes' of emissions. The Roadmap is concerned with scope-1 and scope-2 greenhouse gas emissions in Amsterdam.

Scope 1
Direct CO_2 emissions

'Scope 1' emissions are direct CO_2 emissions within Amsterdam's municipal borders. Examples include factory emissions, the combustion of natural gas in a boiler, or the combustion of petrol in a car. This does not include the emissions caused by the generation of electricity and heat, because part of the energy that is generated is consumed outside Amsterdam.

Scope 2
Indirect CO_2 emissions

'Scope 2' emissions are emissions related to the consumption of electricity and heat in the city. The generation of this electricity and heat in and beyond Amsterdam results in emissions. Scope-2 emissions are attributed to the parties that consume this energy. This is done using emissions factors: what is the average emission per generated kilowatt-hour (kWh) of electricity or gigajoule of heat? As the Netherlands has one large electricity grid, the same emissions factor is used in the calculations for the whole of the country, including Amsterdam. When it comes to heat, a specific emissions factor is used for each heat source.

Amsterdam's efforts in the field of solar and wind energy are contributing to a fall in the national electricity emissions factor. Green electricity contracts in Amsterdam also form part of this.

Scope 3
Emissions outside Amsterdam

'Scope 3' emissions are all other emissions that are caused outside Amsterdam as a result of consumption in Amsterdam. This includes the materials we use in construction, consumer goods, and the meat, dairy and other foodstuffs that we consume. The reduction of scope-3 emissions is addressed in the *Circular Amsterdam 2020-2025* programme, and does not form part of the Roadmap.

Emissions caused by waste incineration

Due to the municipality's close ties with the AEB Amsterdam waste-to-energy plant, in a departure from the GPC protocol, the decision was made to count emissions from AEB caused by the incineration of non-biogenic waste fully as part of the emissions from the Municipality of Amsterdam (both current and future), even though part of the electricity generated at AEB is consumed outside Amsterdam. As the emissions caused by waste incineration are not included in Statistics Netherlands' national electricity emissions factor, there can be no question of double-counting.

What falls beyond the scope of this Roadmap?

Circular economy

Amsterdam has launched an ambitious programme to become a circular economy by 2050, *Circular Amsterdam 2020-2025*. The aim is to become a city where waste is used as fuel, cycles are closed, products and buildings are designed differently, and more things are shared. As explained above,

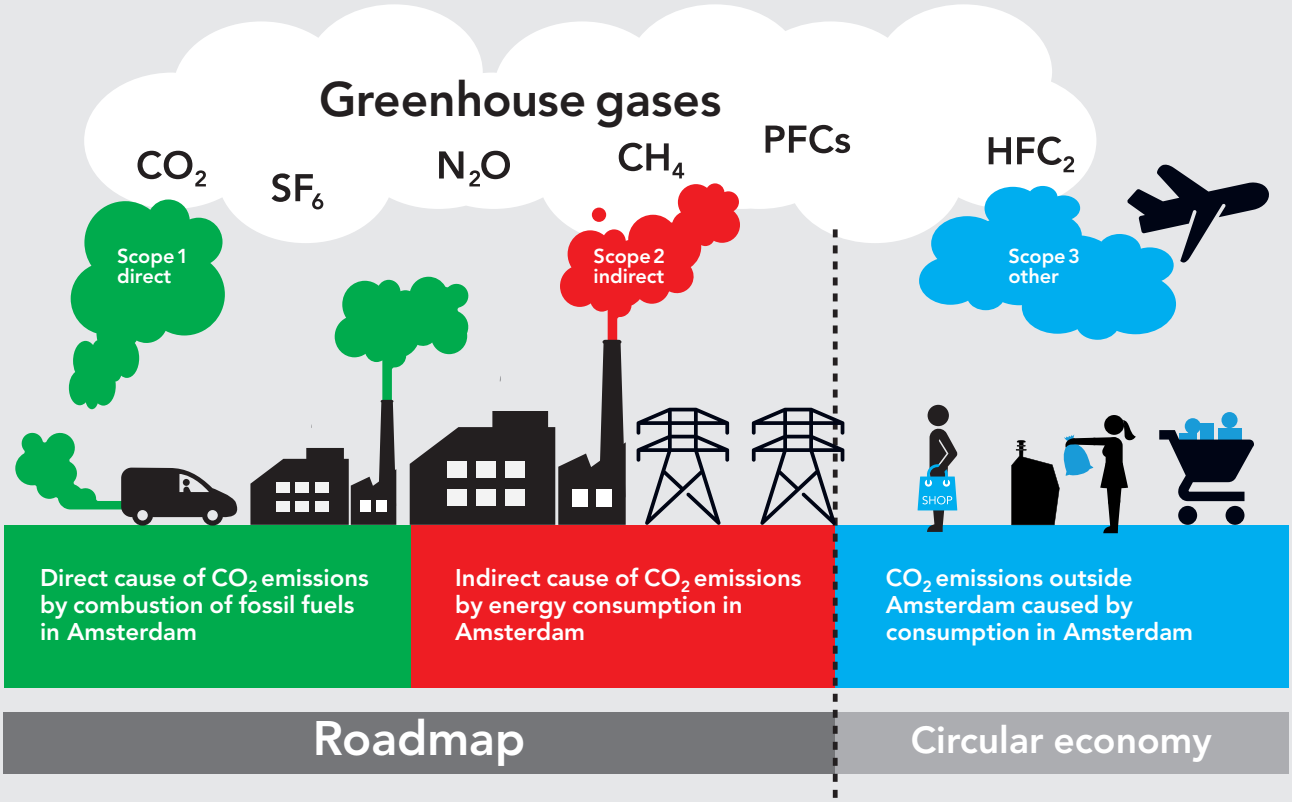
the programme focuses on reducing scope-3 emissions. We are also working on a separate Food Strategy.

Climate adaptation

In addition to reducing greenhouse gases in order to combat global warming, the city also faces the important challenge of managing the consequences of climate change. Climate change is a fact. The rise in average temperatures is bringing extreme weather, with alternately wetter, dryer and warmer conditions. Water security is also becoming increasingly important, due to the threat of flooding. In order to prepare the city as well as possible for the effects of climate change, the Amsterdam Climate Adaptation programme has set the target of drafting an implementation plan with partners in the city in 2020.

Peatlands

The peatlands surrounding Amsterdam are decomposing, releasing CO_2. As explained above, these emissions are not covered in the Roadmap's CO_2 reduction targets, but they are relevant. If the ground becomes wetter, there are fewer emissions; peatlands can even absorb CO_2. Amsterdam's memorandum on the sustainable landscape (*Nota Duurzaam Landschap*) includes an action plan to tackle the climate challenge in agriculture and land-use. Together with other authorities and agricultural and nature conservation organisations, for example, Amsterdam has established a programme for waterlogging peatland in Waterland. The areas surrounding the city offer opportunities for more environmentally friendly land-use, including the planting of trees.



2.2

Understanding the effects

We have done calculations to understand the effects of the planned actions and measures by central government, residents, companies, institutions and the Municipality of Amsterdam. Calculations have been done for each of the four transition paths, and also divided over the different portfolios. The expectation is that in 2030, emissions will be 48% lower than in 1990. This estimate, the most plausible development, is known as the 'estimate for 2030'.

The estimate for 2030 is almost in line with the national ambition of a 49% reduction by 2030, compared to 1990. A 48% reduction in emissions in Amsterdam would mean a reduction of 3,010 kt compared to current emissions (the situation in 2017). This is 280 kt away from Amsterdam's ambition (-55% emissions by 2030, compared to 1990). Given the uncertainty surrounding how far we will succeed in implementing the planned actions and measures, and the size of the effects, we include a range in our calculations. The range is between -21% and -55%, meaning that our ambition of -55% lies just within the range.

In order to achieve this ambition, the planned actions and measures must be implemented successfully and in full. Additional efforts will also be needed. Many actions and measures still need to be worked out, and policies have to be developed and adopted in most cases. The PBL's 2019 policy brief *Het Klimaatakkoord: effecten en aandachtspunten [The Climate Agreement: effects and key issues]* concludes that the National Climate Agreement will lead to a fall in emissions of between 43% and 48%. Despite the strong population growth, with an expected reduction of 48%, Amsterdam is at the upper limit of this national range. We are therefore well-placed to take additional measures to achieve a reduction of 55% by 2030.

Calculation per transition path

A reduction of 48% compared to 1990 levels means a reduction of 60% compared to 2017. We expect to achieve the greatest reduction in emissions in the Mobility transition path (-76% in 2030 compared to 2017). For the Electricity transition path, we expect a reduction of 71%; for Harbour & Industry, 65%; and for the Built Environment, 29%. The majority of the reduction in the Built Environment is expected to take place after 2030.

Calculation per portfolio

The current carbon emissions for each transition path and the estimate of emissions in 2030 have been refined for each portfolio. For this purpose, each emissions category has been linked to the portfolio where the emissions and reductions take place. Private-sector electricity consumption has been linked to both the Economic Affairs and Sustainability portfolios, due to their shared responsibility for this area. More details on the methodology used can be found in the technical report on the Roadmap.

Emissions in 2030 are expected to be

48%

lower than in 1990

How were the calculations made?

The estimate for 2030 consists of four elements:

National impact (autonomous development)
The reduction of emissions due to national actions and measures (such as greening electricity generation and compulsory energy labels for offices; Amsterdam contributes to these developments).

Impact of measures in Amsterdam
The reduction of emissions due to actions and measures by residents, businesses and institutions in Amsterdam and the Municipality of Amsterdam.

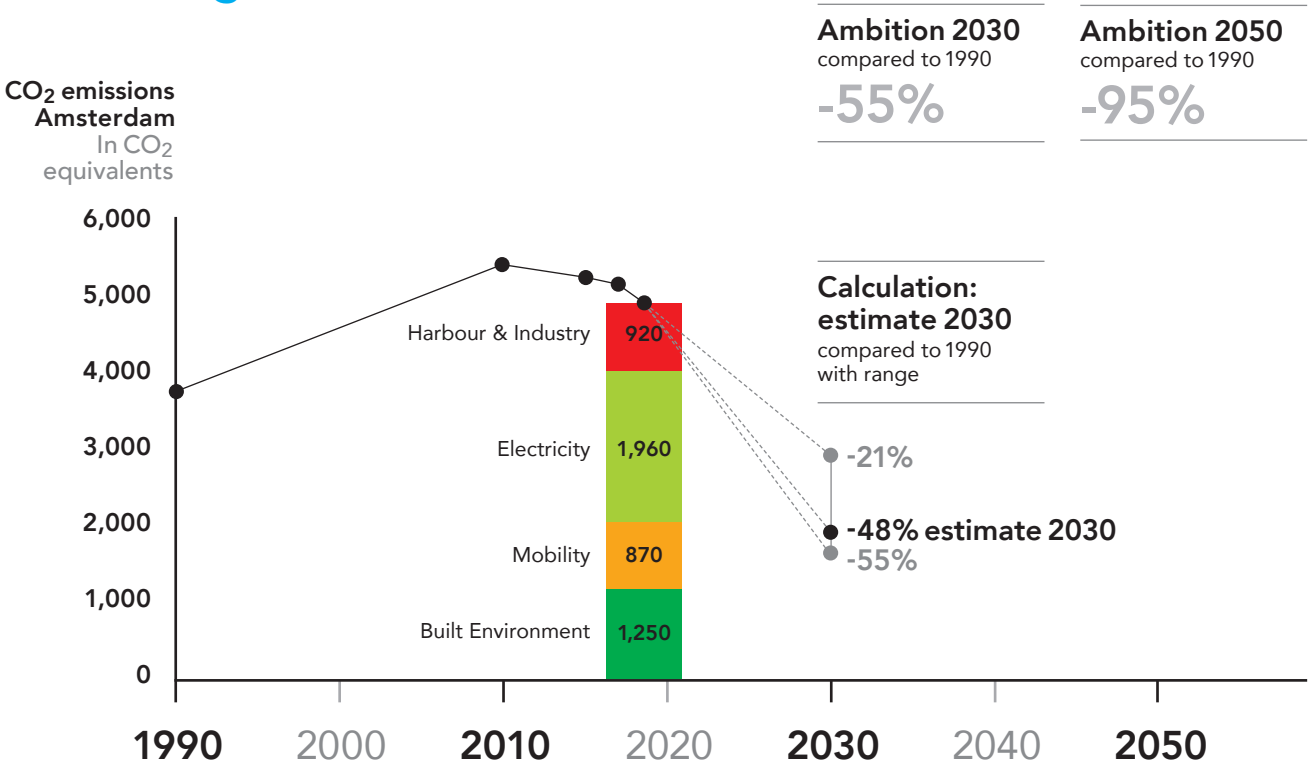
Substitution effects
Changes in energy consumption that lead to more or fewer emissions (for example, the shift to using electric cars instead of conventional cars, or heating homes with electricity instead of natural gas).

With an expected reduction of 48%, Amsterdam is at the upper end of the national range

Growth of the city
Extra emissions caused by new homes, buildings, residents and visitors.

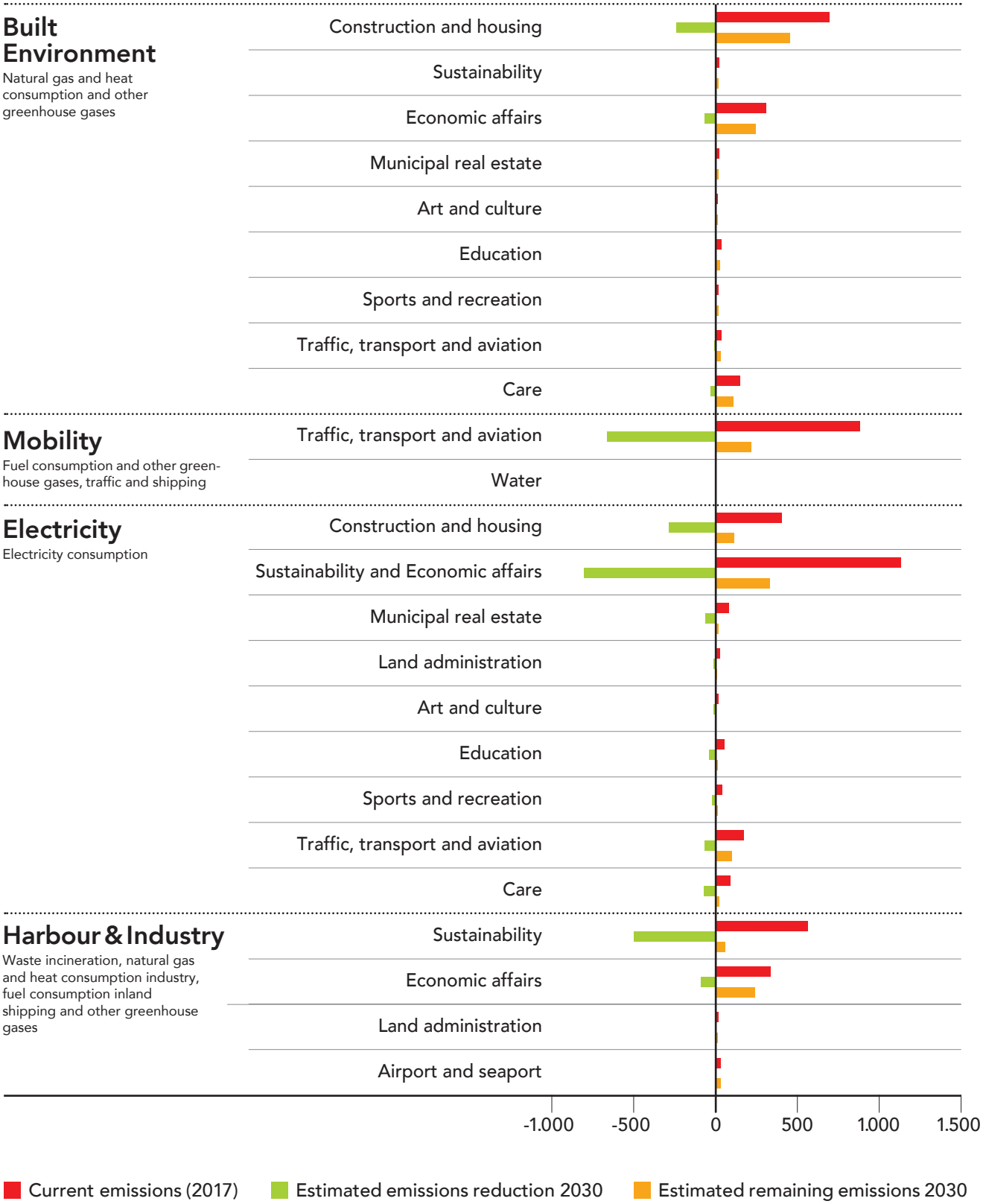
Of the total estimated reduction of 3,010 kt in 2030, 1,830 kt is a consequence of autonomous developments/state policy, mainly the greening of electricity generation in the Netherlands. In addition, 1,350 kt of reduction is the consequence of measures taken in Amsterdam. The measures with the largest reduction effects are phasing out natural gas in the city, environmental zones for motorised transport, and carbon capture at AEB. Due to the growth of the city, emissions are expected to increase by 170 kt, due to the extra electricity consumed by new housing, new offices and possibly extra datacentres. In the calculation, Amsterdam's efforts in the field of solar and wind energy form part of the autonomous development, as they contribute to improving the national electricity emissions factor; this leads to fewer CO_2 emissions per generated kWh of electricity. Amsterdam's efforts in

Reversing the trend



Carbon emissions for each portfolio

(in kt)



relation to solar energy and wind power are presented separately.

The calculation was made with support from experts at CE Delft consultants, and based on various key figures and insights from publications such as the PBL's *Climate and Energy Outlook 2019*. Measures that lack a sufficient degree of specificity are not included in the calculation.

Below, we explain the actions and measures that will have the greatest impact on reducing emissions in each transition path. A full overview of the measures is described substantively in chapter 3 of this Roadmap. The greatest uncertainties (threats and opportunities) are also addressed below for each transition path. If these uncertainties come to pass, this will result in a larger or smaller reduction than estimated. The uncertainties have been included in the range of the calculation.

The Built Environment

Phasing out natural gas consumption in the built environment (with measures including the district-by-district gas-free approach and the *Warmtemotor*) will lead to the greatest drop in emissions. This result is highly dependent on national legislation and financial support from central government. Financial support will have a significant influence on the extent to which residents have a financial incentive to disconnect from the natural gas grid. The municipality is presently taking all the necessary preparatory steps, so the approach can be accelerated in the near future.

Mobility

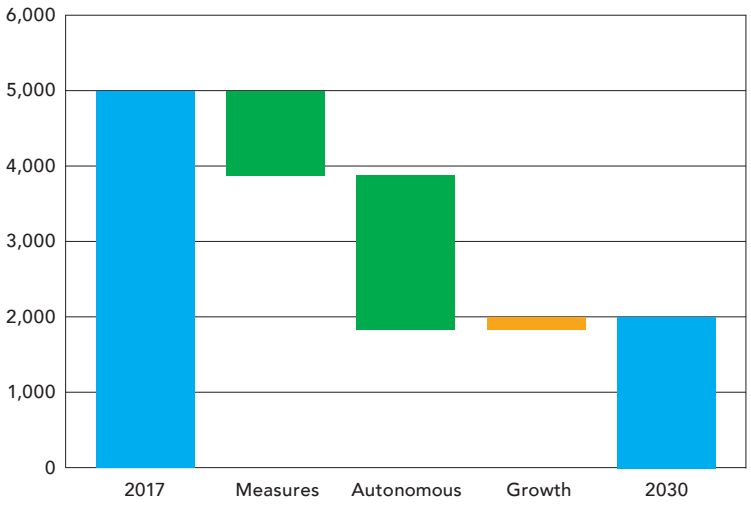
The 2019 Clean Air Action Plan provides for a sharp drop in emissions by greening the vehicles in Amsterdam's municipal fleet. The parking policy and the programmatic approach to cycling, limited car traffic and Smart Mobility must ensure that there is no increase in motorised traffic, despite the additional residents and employees. The ambitions of the Clean Air Action Plan are partly dependent on state policy, such as the outcomes of the state evaluation of environmental zones in 2022. Whether the municipality is given a mandate to introduce these will be a critical success factor in reducing carbon emissions from transport. The transition to electric vehicles must also be facilitated by an adequate charging infrastructure.

Every category of CO_2 emissions is linked to a portfolio

Electricity

Greening electricity generation in the Netherlands, to which Amsterdam contributes via the RES, will lead to an enormous drop in emissions. New-build homes and offices (including datacentres) and electric heating for existing homes and offices will result in increased electricity consumption. More electric cars will also lead to more electricity consumption. Despite the expected rise in electricity consumption and the corresponding emissions, total carbon emissions are falling and expected reductions are considerable in this transition path, due to the increasingly sustainable generation of electricity. The degree to which electricity generation in the Netherlands can be greened successfully will have

CO_2 emissions and expected reduction



Project in the spotlight

Boosting sustainability, one step at a time

The Aeckerstijn apartment complex, built in 1965, once used as much as 500,000 cubic metres of gas each year. Insulation measures have cut gas consumption drastically. Consumption can even be reduced to 75,000 cubic metres, says Henk van 't Kruis, who sits on the owner-occupier association's committee.

"In 2011, we insulated the whole of the back of the building", says Henk. "Single glazing was replaced with high-efficiency glazing in 120 flats. The new facade panels have 10 centimetres of insulation."

"After that, we replaced the gas-fired boilers, which dated from the 1980s. They were losing so much heat that you couldn't walk there, it was so hot."

"In 2017, we split the heating and the hot water and replaced the boilers with high-efficiency models. This saved 200,000 cubic metres of gas a year."

"This year, we insulated the western wing at the front, without a subsidy. To qualify for the state subsidy, you have to insulate at least 15 square metres of glass surface in each home. You won't manage that if you're just doing the front. We were allowed to include the extra insulated doors, but not the new facade panels. They should be more flexible about such things."

There were more setbacks to come. "We wanted to get rid of those cantilever windows that open outwards, so we installed gratings in every flat at the back of the building: they allow you to regulate the indoor climate much more effectively, and you lose less heat. But we didn't get this past the building inspectorate; we were allowed the gratings, but they couldn't be visible. So now they are behind the parapet panel. Why were we allowed the gratings at the back, but not at the front? Owing to all the setbacks, we are now short of the six hundred thousand we need for the last sixty flats at the front."

an impact on how much Amsterdam can reduce carbon emissions. In order to be able to achieve this, the city's current energy infrastructure must be radically updated. This will be accompanied by bottlenecks in space, time, funding and human capacity. Developing the right energy infrastructure in good time is one of the most important critical preconditions for the transition from fossil to renewable energy.

Harbour & Industry

The storage and use of CO_2 (Carbon Capture, Storage and Utilisation, CCSU) at AEB has the potential to lead to a substantial reduction in emissions. Central government is providing SDE++ subsidies for this. In addition, the European ETS and the national carbon tax should lead to reductions in industrial emissions. Carbon capture at AEB is subject to uncertainty about selling the plant, and this may delay the building of a carbon capture facility. Developing a carbon infrastructure is a precondition for re-using captured CO_2 or storing it under the North Sea. On the other hand, should the national carbon tax be made more ambitious, this may lead to more reductions than estimated.

Creating a supply of carbon-reduction plans

Emissions in Amsterdam are expected to fall by 48% by 2030, compared to 1990. This is practically in line with the national reduction target of -49%. Amsterdam's ambition of -55% lies just within the range of the calculation. In order to be able to achieve this, the planned actions and measures must be implemented successfully and in full. Additional measures will also be needed. These measures are not immediately available and implementable, and have yet to be developed. Not only is this true of the period before 2030, but it certainly applies to the period 2030-2050. We need to have potential reduction measures to hand in case current measures

The storage and use of CO_2 at AEB has the potential to cut emissions substantially

are insufficient, the pace is too slow, or we identify opportunities for additional steps.

Searching for and developing a 'stock' of potential carbon-reducing measures is a standard part of the Amsterdam Climate Neutral programme. We are adding new ideas, and we sometimes drop potential measures on the grounds that they are not feasible, suitable or opportune. The list of measures is constantly being developed, with innovation playing a crucial part in this. The AMS Institute (Amsterdam Institute for Advanced Metropolitan Solutions) and the Municipality of Amsterdam's Chief Technology Office (CTO) and Chief Science Office (CSO) will play roles here. The planned Knowledge and Innovation Agenda will contribute to the process.

At present, we are considering investigating the following additional measures to allow us to meet our CO_2 targets in 2030 and beyond:

- Further agreements with (private) landlords on greening real estate
- Intensify agreements with owners and tenants of social and civic buildings
- Research on further reducing the influx of motorised vehicles into the city
- Energy-saving datacentres
- Intensify CCS at AEB (beyond planned annual 500 kt capture of CO_2)
- Boost electrification industry
- Additional efforts to achieve an adequate energy infrastructure

We are working with the relevant departments of the Municipality of Amsterdam and other parties in the city to explore and develop additional measures. These will form part of the annual reporting on the Roadmap.

A number of uncertainties surround the degree to which we will succeed in implementing the measures and the size of the effects. Other unforeseen events may also

influence emissions. In addition, when it comes accelerating the pace, we are highly dependent on regional, national and EU developments regarding regulations and resources. Central government is crucial for Amsterdam, for example in relation to the instruments available for phasing out natural gas, the carbon tax for industry, and the environmental zones policy.
In conclusion, Amsterdam needs to make major and continuous efforts to:

- ensure the implementation of actions and measures in practice, and report on progress;
- scale up existing measures;
- create a supply of carbon-cutting plans, and implement these if necessary and feasible.

The continuous search for new carbon-reducing measures is a standard part of the Amsterdam Climate Neutral programme

2.3

Updating the Climate Budget

We have a good understanding of the challenges ahead and the impact of the planned actions and measures. Whether progress is made will be clear from the annual reporting on the Roadmap.

We have a good understanding of the challenges ahead and the impact of the planned actions and measures. Whether progress is made will be clear from the annual reporting on the Roadmap.

We will update the quantitative part by providing annual updates on the Climate Budget. These will cover the development of CO2 emissions in Amsterdam, as well as progress with the other standard indicators. We will both reflect on the past and look to the future.

Looking back: what progress has been made regarding our (core) indicators, the measures and necessary preconditions, and energy consumption in Amsterdam? Did the measures have the intended effect? With (core) indicators, there will sometimes be a delay in the availability of up-to-date data. With measures, we will often be able to reflect using current data; and when doing so, it is also important to reflect qualitatively.

Looking ahead: are we on course to achieve our CO2 ambitions (-55% by 2030 compared to 1990, and -95% by 2050)? The estimate for Amsterdam's CO2 emissions in 2030 will be updated annually in a standardised way. We will present the results for each transition path and portfolio.

The updated calculations may show that we are not yet achieving our carbon ambitions. In that case, we will include additional measures in the annual reporting on the Roadmap. This could mean, for example, that if progress on a measure for a particular transition path is falling short, extra efforts may be needed in that same path, or it may be decided that extra efforts are needed in another transition path. In some cases, more funding, different technologies or new regulations will also be needed to implement measures. By working with annual updates, we can explicitly weigh up the options and set priorities.

The Municipality of Amsterdam is continuously searching for innovative ways to improve the Climate Budget, allowing us to chart our progress more frequently, precisely and topically. We are considering opening up new data sources and using new visualisations, such as the Climate Clock approved by the City Council. A draft version of this is expected to be ready in 2020.

Annually selecting, prioritising and adjusting

Jafar Beshnam

Owner of the friendly Ja & Ro hairdressing salon in Kinkerstraat

"When I think of sustainability, I think of water, gas and electricity; and nature, too. We've lowered the high ceiling in our salon and have bought LED light-bulbs. That was initially to save energy, but we're also doing it for our two grand-children, so they will enjoy healthy and clean air in the future."

"There aren't any solar panels on this building. The owner of the building is responsible for arranging that. It's a bit difficult to make your own plans for such things, but we are prepared to cooperate. We'd also like to separate our waste more, but there are no separate bins in the neighbourhood. And you're not going to walk down two streets to get rid of your plastic and paper."

"We initially became more sustainable to save energy; but we're also doing it for our two grandchildren, so they will enjoy healthy and clean air in the future."

"We do separate our waste at home in Purmerend, and we take public transport to work in Amsterdam. These are small things, but they do add up. I think that we'll take more measures in the future. We already have double glazing, but now we're going to take a look at our insulation, too. Perhaps other things as well, but I'm not sure yet."

Chapter 3
The transition paths

The Built Environment

3.1

The Built Environment

By 2050, all buildings in the city must be heated sustainably. The focus is thus on replacing natural gas with alternative heat sources (before 2040) *and* saving energy. The greatest challenge lies in the existing city: our homes, commercial properties, offices, and social and civic buildings. An intervention will be required in every building. In order to achieve our ambitions, we will need more alternative sources of heat and to develop the necessary (heating) infrastructure. Action is being taken behind every front door, every facade and in every street. Thousands of new buildings are being built every year, and we must avoid a situation in which carbon emissions rise as a result.

What is the challenge?

Homes and buildings must be great, healthy and affordable places in which to live and work. Every building will be natural gas-free by 2040, and climate-neutral by 2050. We want to reduce the demand for heat and electricity, and offer a renewable alternative to heat our buildings. This applies to housing, but also to shops, offices and companies and buildings with a social function, such as hospitals, schools, sport complexes and museums. Some of the buildings with social and civic functions belong to the municipality.

We must not add to the existing challenge. When it comes to new-builds and transformation projects, we must therefore be sure to use the most recent sustainable building technologies and systems in order to deliver buildings that are already energy-neutral or even energy-producing.

In order to facilitate this, the energy infrastructure will undergo a transformation. Although we do not yet know what exactly the future energy infrastructure will be like, we do know that it will require large investments and a lot of organisation, and that it will have a major impact on public space and the substratum.

Built Environment

CO_2 emissions

1,250 kt

Share of total CO_2 emissions

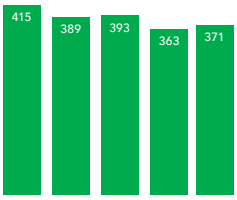
25%

All of these aspects are addressed in this chapter, in three sections:

1. A natural gas-free built environment
2. Energy-efficient buildings
3. Climate-neutral urban growth

Consumption and CO_2 emissions

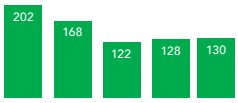
Housing natural gas consumption



mln.m³

648 kt (52%)

Business market natural gas consumption



mln.m³

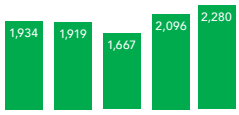
263 kt (21%)

Social & civic buildings natural gas consumption

mln.m³

222 kt (18%)

Housing and other buildings heat consumption



TJ

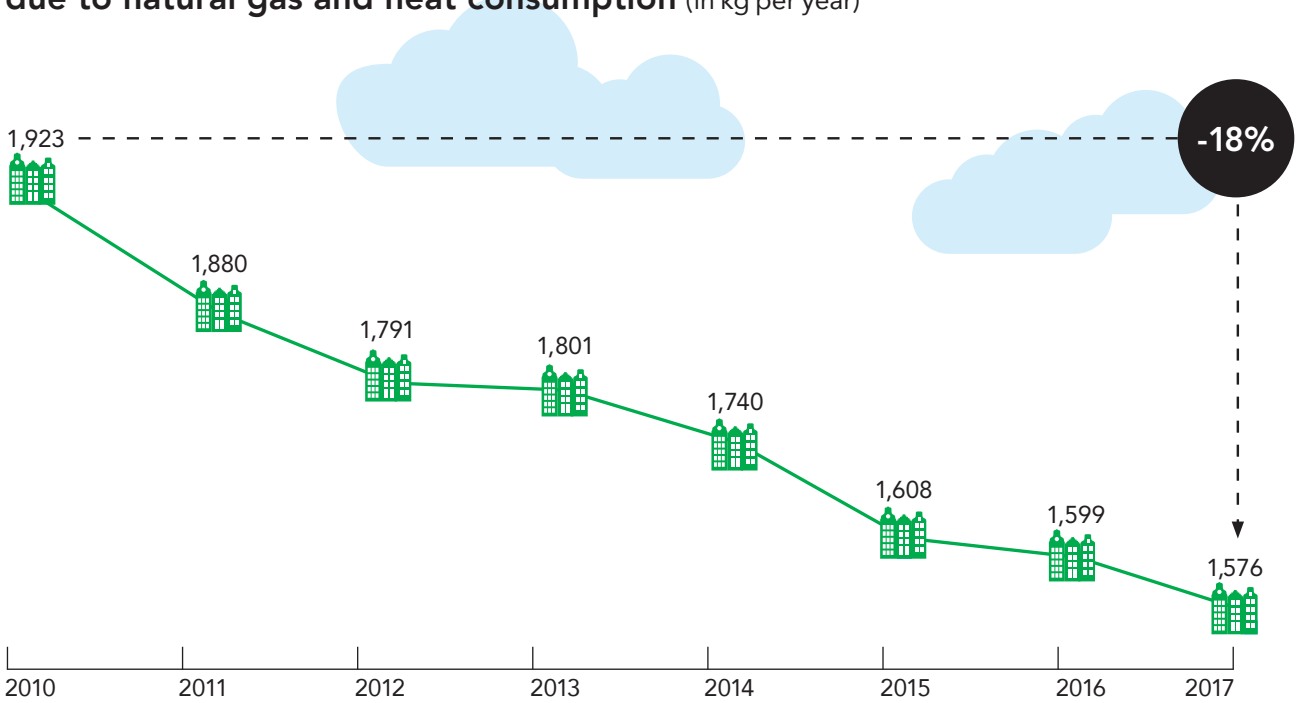
68 kt (5%)

Other greenhouse gases

N/A no energy consumption

49 kt (4%)

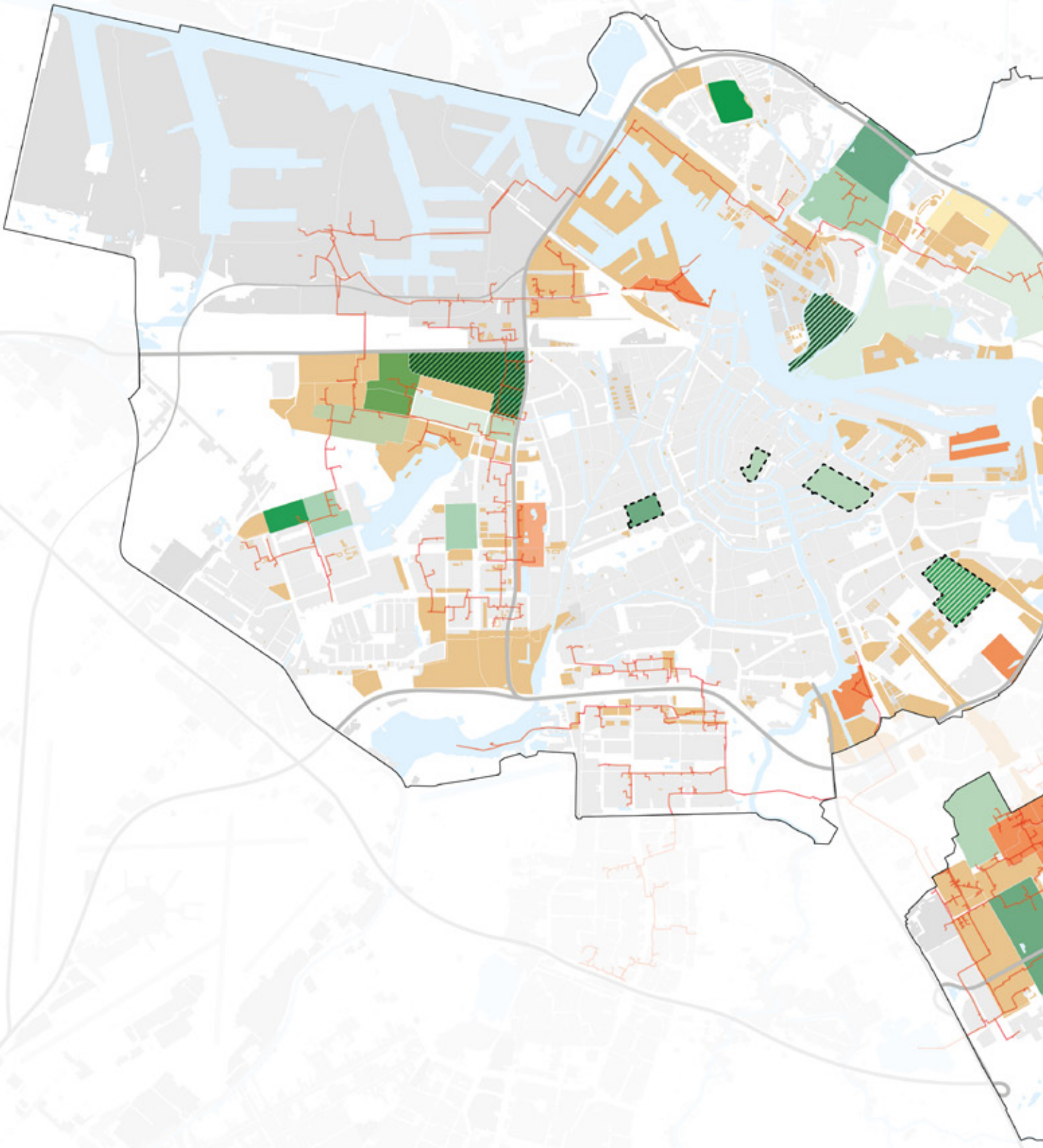
Average CO_2 emissions per home due to natural gas and heat consumption (in kg per year)

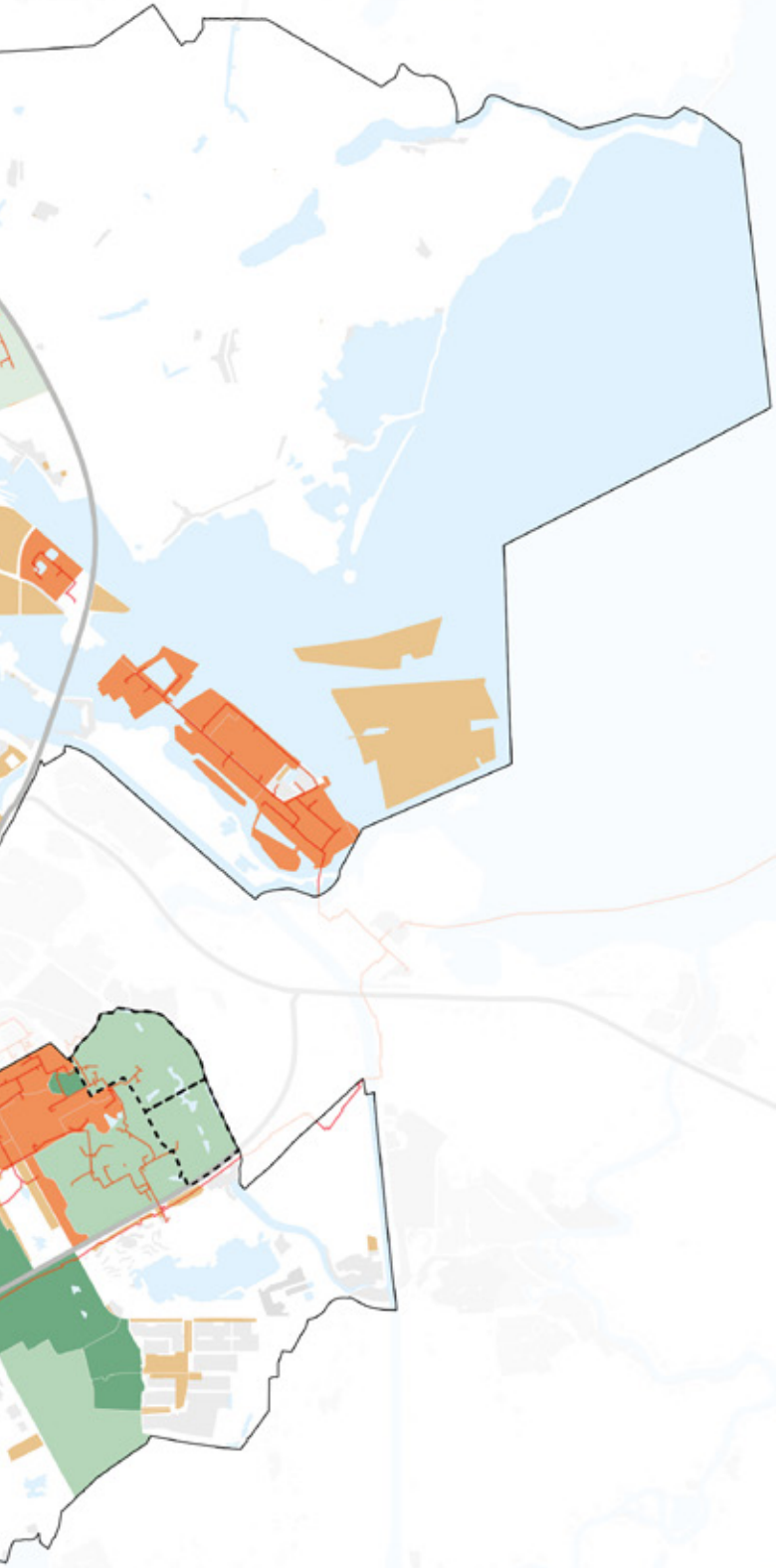


The Built Environment

A natural gas-free built environment

A natural gas-free built environment





What does this map show?

In order to phase out natural gas in the city by 2040, the number of natural gas-free home equivalents must increase from 91,000 to 650,000 in 2040. To achieve this, we are following three lines. With the WAM approach, we are tackling the city district by district. Together with the City Deal Amsterdam partners, we are working in neighbourhoods to draw up plans with residents to disconnect districts and neighbourhoods from the natural gas grid. Residents are also taking the initiative in certain neighbourhoods in the city. We are supporting them, and they form part of our approach. New-build areas will naturally be designed in such a way that they are no longer dependent on natural gas. The number of alternative technologies and renewable sources will increase. The city's existing heat distribution grid will supply a considerable share of the natural gas-free neighbourhoods with heat, and increasingly sustainable heat in future.

Key

Existing situation

- Existing urban area
- Existing business park
- Existing heat distribution grid
- Natural gas-free neighbourhood

Phasing, neighbourhood transition to natural gas-free *(reference date 22-1-2020)*

- Unknown
- Intention (phase 0)
- Initiative/orientation (phase 1)
- Basic principles/feasibility (phase 2)
- Definition/design (phase 3)
- Implementation (phase 4)
- Transition neighbourhoods: private initiative

Mixed phasing, neighbourhood transition to natural gas-free

- Phase 1 and phase 4
- Phase 1 and phase 3
- Phase 2 and phase 4

Future development

- Natural gas-free new-builds

3.1

A natural gas-free built environment

Natural gas will be phased out in the built environment, but there is still a long way to go. Around 90% of all buildings are still heated with natural gas and connected to the natural gas network, and these buildings will therefore need to be supplied with a different form of heat. We will do this by creating alternatives district by district, such as sustainable district heating, local waste heat or aquifer thermal energy systems. Amsterdam has a growing heat distribution grid, but only part of it is currently sustainable. Smaller district-based heat distribution grids are also being developed. Building these grids is a major undertaking in our city's public space, both above and below ground; it is visible and causes disruption. More demand for heat will mean more demand for renewable sources, and these – including geothermal heating, aquifer thermal energy and waste heat – will be developed. The great challenge lies in accelerating the pace of the district-based approach: in building the infrastructure and the rate at which we develop renewable sources.

What is the challenge?

The challenge is to phase out the use of natural gas in the built environment by 2040 at the latest. This comes down to 650,000 home equivalents (housing and other buildings converted into home equivalents). The transition is not expected to follow a neat straight line. In 2019, there were 91,000 natural gas-free home equivalents; in 2030, we expect there to be around 260,000; and the remaining 390,000 will follow in the period up to 2040. In line with international agreements, the National Climate Agreement and Amsterdam's own climate-neutral ambitions, we will ensure that all heat used in buildings comes from sustainable sources by 2050 at the latest. In the coming years, we will work towards investment decisions in 28 neighbourhoods; all relevant parties in the neighbourhoods will invest to disconnect existing buildings from the natural gas grid. In any case, this should lead to three districts, around twelve neighbourhoods, taking irreversible steps to phase out natural gas by 2022.

Pillar 1
Scaling up the natural gas phase-out, district by district

Pillar 2
Developing sustainable sources for the heat distribution grid

Pillar 3
Building a city-wide heating infrastructure

We will work for a fair transition to a natural gas-free city. The phase-out of natural gas in Amsterdam is a system change that we are tackling on a district-by-district basis. We are already working on this, and will keep expanding until the whole city is underway. This is conditional on the growth of sustainable heat sources and the necessary heat infrastructure. How to achieve this growth in sources and infrastructure is the focus of the heat strategy. The municipality cannot, does not want to and will not tackle this challenge alone. The City Deal Amsterdam Natural Gas-Free was agreed back in 2016. We are working on this large and complex task in partnership with housing corporations, network companies, power companies and !WOON.

This results in the following three pillars of the natural gas-free approach:

Pillar 1
Scaling up the natural gas phase-out, district by district

Pillar 2
Developing sustainable sources for the heat distribution grid

Pillar 3
Building a city-wide heating infrastructure

Pillar 1
Scaling up the natural gas phase-out, district by district

The district-based approach is well underway; the city currently has a learning environment of c. 28 neighbourhoods. Most of these neighbourhoods are owned by housing corporations, but they include neighbourhoods with local initiatives. Together with residents, companies, corporations and energy companies, we are developing plans in each neighbourhood to make the transition to an alternative source of heat. Changes to legislation and regulations, such as the Heating Act (*Warmtewet 2.0*) and the Environmental and Planning Act (expected in 2022-2024), will give the municipality more instruments to scale up the district-based approach. At present, the existing district-based approach is being expanded into a city-wide systematic approach in a constantly-accelerating process. Below, we describe the key elements of the district-based approach.

Learning environment

At the end of 2016, the 'Towards a natural gas-free city' strategy was adopted. The municipality, housing corporations, tenants' associations and energy companies agreed to cooperate on the transition in the City Deal Amsterdam Natural Gas-Free. The strategy is based on disconnecting neighbourhoods from the natural gas grid, step by step. Such an operation had never been carried out before, meaning that there is no blueprint for the approach. We are therefore gaining knowledge and experience as we go, and we are working with partners and residents in practice.

Almost three years on, hard work is taking place with the City Deal partners in c. 28 neighbourhoods on plans for alternatives to natural gas. The first successes can be reported. In three neighbourhoods – Van der Pek in Noord, the Wildeman and the Dobbebuurt in Nieuw-West – an actual start has been made on disconnecting homes from the natural gas network.

There is no blueprint for the approach

We are working towards a process and organisation whereby we can scale up in future: more districts and neighbourhoods will be tackled in parallel, at a faster pace. With the City Deal partners, we have developed a procedural and decision-making model known as 'WAM': Wijken Aardgasvrij Maken, 'making districts natural gas-free'. This draws together the procedural steps and decision-making moments for all relevant parties, including municipal departments such as Mobility and Public Space and City Development, and Waternet. This creates a common language, transparency and uniformity, thereby leading to an acceleration in the decision-making process, lower social costs and affordable alternatives for residents. Once the pace has picked up, we will have an operation that is comparable to the large urban development projects of the 1970s and 1980s.

Transitievisie Warmte

This large-scale operation is based on the vision document on the heating transition, the *Transitievisie Warmte*, which will be finalised in the first half of 2020. The aim is to give residents and businesses in neighbourhoods more certainty about the objectives. The document sets out the timeframe for disconnecting neighbourhoods from natural gas and the 'preferred' alternative heat sources that are most readily available. It considers the city as a whole and the available sources at the municipal and neighbourhood levels. All of the existing real estate in a district is addressed: homes, commercial buildings, offices, restaurants, social and civic buildings such as schools, and other buildings.

With local residents, companies, energy companies and other stakeholders, we then hold a discussion about implementing the vision, and make implementation plans.

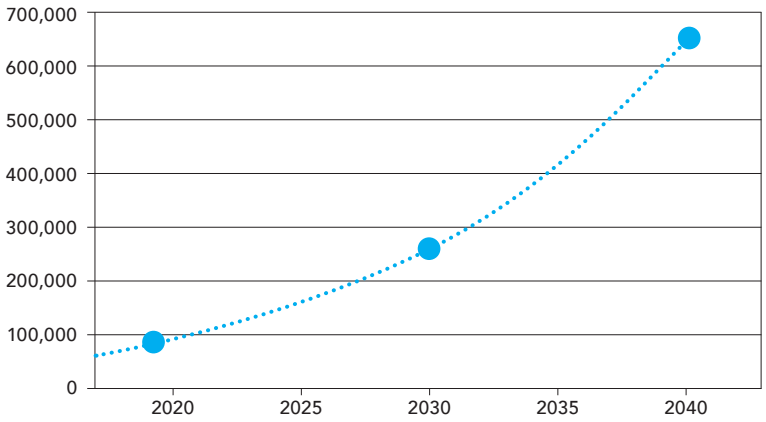
The plans zoom in on the neighbourhood, and the *Transitievisie Warmte* is developed further. The schedule is made more specific and the preferred solution is developed in greater detail, including any exceptions. This is helped by the fact that when drawing up the *Transitievisie Warmte*, we focused on ideas that were broadly supported in Amsterdam. Before making a start on analysing, calculating and finalising the vision document, we used surveys and consultation evenings to find out from citizens what they considered important and logical when phasing out natural gas. Experts from housing corporations and energy companies also contributed key issues.

Participation and communication

Based on our experiences, we are developing a participatory and communicative approach that focuses on defining supported, collective, preferred solutions for the neighbourhoods covered in the vision document. It is essential that we use our communicative approach to explain to residents why there is a preference for a certain technology in a certain neighbourhood. At the neighbourhood level, the participatory approach ranges from organising residents' influence on selecting an alternative heat solution for a neighbourhood, to involving residents in the district implementation plan.

We need to be able to explain to residents why a certain technology is preferred in a neighbourhood

Estimate of natural gas-free home equivalents
(of existing buildings in Amsterdam in 2019)



There is space for discussion and negotiation with residents, for example on the route through the district and the associated disruption, the changes required in homes, and the collective purchasing of insulation or induction hobs.

A large-scale roll-out of the district-based approach will only be feasible when the participatory and communicative approach has been standardised.

The City Deal and the *Amsterdamse Warmtemotor*

As explained above, we are tackling this challenge in the context of the City Deal. One of the City Deal projects is the *Amsterdamse Warmtemotor*. The municipality, the city's housing corporations and power companies (Vattenfall and Westpoort Warmte) are jointly investigating the options for connecting c. 110,000 homes located close to existing heat distribution grids to these grids by 2030 at a low cost. This is conditional on the residents being offered an affordable and sustainable solution. The *Amsterdamse Warmtemotor* is not only working on the major step of disconnecting a large number of homes (owned by corporations, owner-occupier associations and individuals) from the natural gas grid, but also on innovation. How can we carry out the works in people's homes as efficiently as possible, with minimal disruption and as quickly as possible? How can building companies, energy companies and homeowners cooperate optimally? These are all conditions that will contribute to the scaling-up and acceleration of the energy transition.

Development neighbourhoods and phasing out natural gas

There are 32 so-called 'development neighbourhoods' (*ontwikkelbuurten*) in Amsterdam. These are neighbourhoods that merit extra attention, where we are investing in areas such as social facilities, strengthening the local economy, and improving the surroundings and housing quality. The research on the options for

Cooperation in the City Deal Amsterdam Natural Gas-Free

making homes natural gas-free forms part of the improvement of housing quality. That is to say that at an early stage, we consider the opportunities for phasing out natural gas in these neighbourhoods in combination with other tasks and ambitions. These may be physical in nature, but they can also be social themes or related to employment.

Local initiatives

Amsterdam's citizens are increasingly developing initiatives to phase out natural gas, varying from promising individual ideas to advanced collective plans. In many cases, the network of sustainable frontrunners known as '02025' is playing a key role in developing these initiatives. Initiatives are currently being developed in different locations in the city, including the WG-terrein, Middenmeer-Noord, Gaasperplas and Artis. Various initiatives are making use of the municipality's sustainable initiatives regulation, which provides financing for self-organisation and research. In 2020, a new round will be held of the government's so-called *proeftuinen* ('experimental plot') regulation (Ministry of the Interior). The municipality wants to submit one of the citizens' initiatives for a natural gas-free neighbourhood, and is in discussions with the initiators about this.

Subsidies

In many cases, it is not yet possible to make a business case for an alternative energy supply to natural gas. The municipality is therefore stepping in, so that we can make a start on implementing projects in practice. The municipality contributes from the Climate Fund. The subsidy regulations on the district-specific approach to disconnecting from natural gas allow homeowners to take the necessary gas-free measures, and thereby contribute to the affordability of the energy transition. In this phase of the transition, the Climate Fund is intended to facilitate the first projects. More funding is needed, however, and the municipality is working with other local authorities, including the G4 municipalities and the Association of Netherlands Municipalities, to lobby central government for more resources.

Amsterdam's citizens are increasingly developing their own initiatives to phase out natural gas

Further development

In order to scale up the district-by-district approach, we will need enough sustainable heat sources and the required infrastructure will need to be built in the city. This is addressed in the following pillars (2 and 3).

Actions and measures

Transitievisie Warmte: clarity, preferred technology and neighbourhood planning

Planning in 28 neighbourhoods

Participation and communication process in 28 neighbourhoods

Carry out natural gas-free plans in 3 districts /12 neighbourhoods

Implement WAM model

Further develop participatory approach

***Warmtemotor:* connect 110,000 homes to the heat distribution grid**

Investigate opportunities for phasing out natural gas in development neighbourhoods

Support local initiatives

Build (residual) heat infrastructure, Middenmeer Noord

District-specific approach to subsidising phase-out projects

Subsidise incidental projects

Attract external investment

Pillar 2
Developing sustainable sources for the heat distribution grid

A collective heat system with medium-temperature heating would be the most logical solution for c. 50-60% of the city

Source strategy

The transition to a natural gas-free city requires a large amount of sustainable heat. With every home or office that is disconnected from natural gas as a heat source, this demand will increase. It is also important to widen the range of heat sources, so that the system becomes less dependent on one or a few sources. We have made a detailed inventory of current and future sources for meeting the demand for heat in the city, known as the *bronnenboek* ('Amsterdam sourcebook'). Below, we describe how we will get from the sourcebook to a source strategy by fulfilling two tasks: (1) maintaining, extending and greening existing sustainable heat sources, and (2) developing new, alternative sustainable heat sources.

Maintaining, extending and greening existing sustainable heat sources

The key existing sources for the city's heat distribution grid are the waste incineration plant (AVI) run by Amsterdam's waste and energy company (AEB) in the western part of the city, and the gas-fired power station in the eastern and south-eastern part of the city (Vattenfall's Diemercentrale plant). These large power stations generate waste heat, which is released during the production of electricity or processing of waste. Although these existing sources do reduce carbon emissions, because they utilise waste heat, they are not or are only partly sustainable.

From 2020, two biomass heating installations will be connected to the heat distribution grid. These installations – one at the Diemercentrale and the other at the waste incineration plant (AVI) – are viewed as temporary sources that will also need to be replaced with new, cleaner sources in the longer term.

The municipality is investigating the role that AEB's waste incineration plant should play in the future system of sustainable sources. We can already say that in any case, the waste incineration plant must remain available, at its current size and capacity, to supply heat for the coming fifteen years, if we want to avoid becoming dependent on uncertain, newly-developed sources during this period, or on natural gas, if new sources are not ready in time. At the same time, we need to investigate how, and with what implications, carbon capture could be connected to the plant in order to ensure that the heat produced there is 100% carbon-free (see pillar 15, Harbour & Industry). The research will also consider the cost of realising this.

Scenarios for the natural gas-free transition show that a collective heating system with medium-temperature heating would be the most logical solution for c. 50-60% of the city. In some places, though, we will need to start with a high-temperature system, which can be lowered to a medium temperature later. This means that in the period up to 2040, the heat distribution grid may need to supply four times the current heat capacity. Of this, 35-40% will probably consist of individual all-electric solutions (such as home-based heat pumps), smart grids for small collective systems based, for example, on aquifer thermal energy systems in combination with heat pumps or waste heat from data-centres, and c. 15% will consist of hybrid solutions based on green gas.

The development of alternative sustainable heat sources

The development of alternative sustainable sources is still at an early stage. Together with our partners, the municipality is working to accelerate the process. This is being done in three work programmes:

Project in the spotlight

Waste heat for Watergraafsmeer

Heating 5,000 homes in the Watergraafsmeer district using waste heat from a datacentre: that's the aim of the MeerEnergie cooperative. Committee member Ardine Nicolaï describes the recent developments.

"It all began when the grid operator Alliander confirmed that the ice rink was producing enough waste heat to heat 500 homes. Heat that was simply being released into the air, whereas we could be reusing it! This led to the founding of the MeerEnergie cooperative in 2015: renewable energy that is close to home, small-scale, transparent, and managed by residents."

Much has happened since then: MeerEnergie now has 800 paying members, and the Equinix datacentre in nearby Science Park has agreed to provide waste heat for free. In 2020, the municipality will install the underground pipes for the heat distribution grid in Watergraafsmeer-Noord. Ardine: "This is a start. We still need the connections to homes and the source, and the building for the central heat pumps. We're currently searching for a form of cooperation with the municipality that's not in conflict with all kinds of rules. We're looking at how we can manage the business case technically, legally and financially. With Alliander, we're making progress with the business case. You always hit chicken-and-egg-type obstacles with these kinds of projects; it's crucial to have mutual trust in the actions of the parties involved."

"There's still too much focus on the risks and legal obstacles," Ardine continues. "Whereas we should be talking about how we can make this work in a legal sense. The residents want to develop a heat distribution grid, the municipality wants a natural gas-free city; it's an ideal match. But there are still lots of obstacles. The whole of the Netherlands is watching; our example could be copied in all kinds of ways. We won't be able to start building unless we get a subsidy. The condition of the *proeftuin* subsidy is that it must be working by 2028. If we can get all the parties together, we will achieve that."

an aquifer thermal energy programme, a geothermal heating programme and a datacentre waste heat programme.

The aquifer thermal energy programme will be carried out in partnership with Waternet. In early 2021, we expect to be able to start implementing operational aquifer thermal energy projects in the city, if these prove feasible. For example, we are researching the use of aquifer thermal energy in Buikslotermeer, Strandeiland, the Sloterplas lake area and the WG-terrein.

Geothermal heating can offer an important alternative to natural gas if the ground is suitable and there is sufficient heat potential. At present, we lack sufficient knowledge about Amsterdam's terrain. In order to accelerate the research on the suitability of the substratum for geothermal heating, the municipality is working closely with the Province of Noord-Holland and the Metropolitan Region Amsterdam. With the municipality's participation in Energie Beheer Nederland's SCAN programme, seismological research will be carried out in the region until 2020. This programme should deliver information on the substratum that will help to determine whether and where test drilling can start in the substratum. This test drilling will ultimately deliver more detailed information about the feasibility of deep and ultra-deep geothermal heating. The first geothermal heating sources are expected be available for the city from 2030. Based on current technologies, a geothermal heating source with the necessary installations will take up c. 0.5 hectares of space, equivalent to one football field. It is important to reserve this space in good time (see also pillar 20 on space and infrastructure).

Amsterdam is an attractive location for large datacentres, thanks to the available data infrastructure. In various places in the city, the municipality is investigating the degree to which waste heat from datacentres could be used to heat buildings. In Middenmeer, for example, the municipality is supporting a project by a local energy corporation that wants to use waste heat from a datacentre for a heat distribution grid in the district. The municipality has made an investment from the Climate Fund that will allow the heat infrastructure to be built when the district's sewers are replaced. In Haven-Stad, research is being conducted on the use of waste heat from a datacentre.

For a large part of Amsterdam, heat distribution grids are an important and cost-efficient alternative to natural gas

Actions and measures

Draw up a heat source strategy

Determine role of the AVI in the heat mix

Make AVI's heat supply carbon-free by using carbon storage

Carry out Aquifer Thermal Energy programme

Carry out Geothermal Heating programme

Implement Datacentre Agenda

Pillar 3
Building a city-wide heating infrastructure

In large parts of Amsterdam, heat distribution grids offer an important alternative to natural gas and bring the lowest social transaction costs. In a natural gas-free city, the heat supply for existing buildings will mainly be based on two infrastructures: (1) centralised heat distribution grids with large-scale, centralised sources, and (2) decentralised heating systems at the neighbourhood or building level. For new buildings, the preference is for so-called 'low-temperature systems'. Higher-temperature heat distribution grids are suitable for homes that are more difficult or very expensive to insulate.

Centralised heat distribution grids

Heat distribution grids will develop in terms of size and type. We expect to see growth in coverage from c. 15% of the city today, primarily on the edges of the city (West, Nieuw-West, Noord, Oost and Zuidoost), to 50-60% of the city. As a result, the necessary infrastructure will also need to grow; including in some of the older parts of the city within the ring, in the longer term, where the demand for heat will also be quite considerable in future. A key point here is that the infrastructure should not only be developed in districts with the best business case. Every citizen must have the option of disconnecting from the natural gas grid.

Decentralised heat distribution systems

Smaller, decentralised heat distribution grids will also be developed, powered by decentralised, sustainable sources based on shallow geothermal systems, aquifer thermal energy, and waste heat from data-centres, among others. In such systems, electricity will often function as auxiliary energy to raise the temperature of the heat sources to higher usable temperatures. This decentralised infrastructure will often be developed by parties other than those that develop large, centralised heat infrastructures. Take developments and local energy initiatives at the neighbourhood and users' level, for example. In the future, the two kinds of infrastructure may become interlinked.

The Climate Fund is intended to facilitate the first projects in this phase of the transition

Low-temperature heat distribution grids (often decentralised) have an impact on the electricity grid, as electricity is needed to convert the low temperatures in these grids into temperatures suitable for heating homes. These grids use electricity to produce hot tap water for homes. This can be done using industrial collective heat pumps, for example, or individual home-based heap pumps (see also the chapter on Electricity).

A heat infrastructure strategy

In 2020, the municipality will present the optimal infrastructure for a natural gas-free city, looking ahead to the infrastructure we will need in 2040. The strategy will be based on the *Transitievisie Warmte*. We will also outline the opportunities and threats, from a spatial and technical-planning perspective. For example, we see opportunities for the main traffic routes from the edge of the city to the centre,

1990

Fuel mix of the heat supply: natural gas

2019

91.000 home equivalents natural gas-free

In various phases of the process in c. 28 neighbourhoods, work is underway to disconnect buildings from the gas grid: initiatives have developed in the Pekbuurt, Banne-Noord, a number of neighbourhoods in Nieuw-West, Middenmeer Noord, the WG-terrein and in c. 15 other neighbourhoods across the city.

Part of the current fuel mix of the heat supply: natural gas, high-temperature district heating (AEB and Diemercentrale), small share of biomass, heat exchangers

which will be dug up from facade to facade in the coming years in order to replace infrastructure. Examples include the 'Oranje Loper' programme (covering quays and bridges), Burgemeester Röellstraat and Jan Evertsenstraat.

Together with our partners in the city and financiers, the municipality will investigate the conditions under which the heat infrastructure could be tackled as part of these major tasks. The municipality is also investigating which financial instruments could contribute to this development; not only from the municipal Climate Fund, but also potential contributions from central government or Europe.

Strengthening the management of the heat transition

Central government is working on the Heating Act (*Warmtewet 2.0*). This should give municipalities greater control over the development of heat distribution grids, and guarantee that customers are offered a reasonable and affordable heat price. As a member of the Association of Netherlands Municipalities, the municipality will be directly involved in drawing up the new act next year. Amsterdam will make every effort to ensure that this law offers the maximum set of instruments. Together with central government, we are investigating whether it will be necessary to change the way the market is organised. Whereas the whole chain, from source to heat delivery to the client, is currently managed by private parties, we will investigate whether the heat distribution chain could be divided into elements such as source, transport and distribution and supply, as is already the case in the electricity market.

4,000
existing home equivalents are currently being made natural gas-free each year; this must rise to more than
25,000

Actions and measures

Develop a heat infrastructure strategy

Coordinate interventions with other works in the city

Set investment agenda

Lobby central government for a decisive set of instruments

Investigate market regulation of the heat distribution chain

See also pillar 20 on infrastructure-related actions and measures

2030

Circa 170.000 home equivalents need to be disconnected from the natural gas grid to meet the 2040 target

Dozens of neighbourhoods are expected to be in an advanced phase of (preparation for) implementation. *Transitievisie Warmte* will provide more clarity on this next spring

Likely elements of the fuel mix for the heat supply: natural gas, high-temperature and medium-temperature district heating (AEB, biomass plant Diemen, aquifer thermal energy, waste heat from datacentres), heat exchangers

2040

390.000 home equivalents need to be disconnected from the natural gas grid in order to meet the target

All districts have phased out natural gas or are in the process of doing so

Likely elements of the fuel mix for the heat supply: high-temperature and medium-temperature district heating (AEB, geothermal, waste heat from datacentres, aquifer thermal energy), green gas and local heat exchangers

What is at stake and what is our role?

Within the Climate Neutral Roadmap, this is the area where which the municipality is playing a (very) major role in terms of coordination, organisation and resources.

Phasing out natural gas in Amsterdam is a relatively new task that rapidly gained momentum in 2016. The magnitude of the task becomes clear if one realises that in the period until 2040, we will need to intervene in almost every building in Amsterdam, many new sources of heat will be needed, and that a lot of new infrastructure will also have to be installed in public space and the crowded substratum. These interventions will require billions in investment before 2040; some profitable, some loss-making. This has implications for our approach, the roles played by parties – including the municipality – and how we use resources.

First of all, we are dealing with a great many parties, including building owners and users, residents, energy companies, infrastructure companies and (groups of) residents who are developing their own initiatives. With a view to feasibility, pace and social affordability, it is important for these parties to engage in collective action. This will not happen automatically. Leadership will be needed, and coalitions and cooperation will be essential.

The municipality plays a diverse role in this area. Together with our City Deal partners, we initiate and organise processes in an increasing number of neighbourhoods – from the first discussions and ideas to feasible plans. Resident participation in neighbourhoods forms the core of the approach. We ensure that the first homes and neighbourhoods can actually disconnect from the natural gas grid by providing resources to cover the loss-making part of the investment. We need examples, and must learn in practice. A significant part of the Climate Fund is available for investment and subsidies for natural gas-free projects (see also section 4.5 on 'Financing'). At the same time, we are working with central government to ensure the availability of additional funds, which will be needed to make the entire building stock natural gas-free. When actual work begins on building the infrastructure, the municipality will of course coordinate and lead the works in public space and the substratum.

Of the areas covered by the Climate Neutral Roadmap, this is where the municipality is playing a major role

This will only succeed if...

We will only meet our target of phasing out natural gas in Amsterdam by 2040 if we accelerate the process. At present, around 4,000 existing home equivalents are becoming natural gas-free each year; this must rise to more than 25,000 per year. This will mean more district-based approaches, more sustainable heat sources and more heat infrastructure. Two key challenges will be to develop compulsory interventions and keep the social costs manageable.

Our experience shows that taking a voluntary approach leads to high costs and tends to slow the pace. In the longer term, entire neighbourhoods or districts will need to take efficient and organisable steps in one go, so that we – as a society – are not forced to maintain a natural gas infrastructure at a high social cost for those few parties that do not want to participate. We therefore need a more effective set of instruments, which can be used to induce owner-occupiers, owner-occupier associations and other property owners to play their part in the plans in certain areas. The National Climate Agreement underlines the importance of minimising the social costs and of affordability for residents and businesses. In this context, we are calling on central government to bring regulations into line and provide a firm set of instruments.

Building a new system is expensive. We must ensure that we create a system that delivers heat at an acceptable cost for all

parties, including housing corporations, energy companies and authorities, and above all for residents. Who will pay for what, what should government contribute, and which part will be delivered by the market? These challenges raise the overarching question of whether heat distribution grids can and should remain in the private sector, or whether the municipality should play a (different) role here.

Building this new system is an operational task of unprecedented size. Year upon year, we will need to intervene in thousands of homes and commercial buildings, and major works will be carried out in public space in order to lay the necessary infrastructure. In addition to the organisational challenges and enormous demand for skilled labour, this will bring disruption: for the residents and property owners who have to carry out works in their buildings, and in our city's public space. At the peak of the process, works to install or replace infrastructure will be continuously underway in c. 10% of the city.

What are we going to do?

For the municipal organisation, the greatest energy-saving potential lies in the municipality's offices and yards. The municipality aims to make these offices and yards natural gas-free by 2030. Around 95% of property in the municipality's total real estate portfolio is still connected to natural gas.

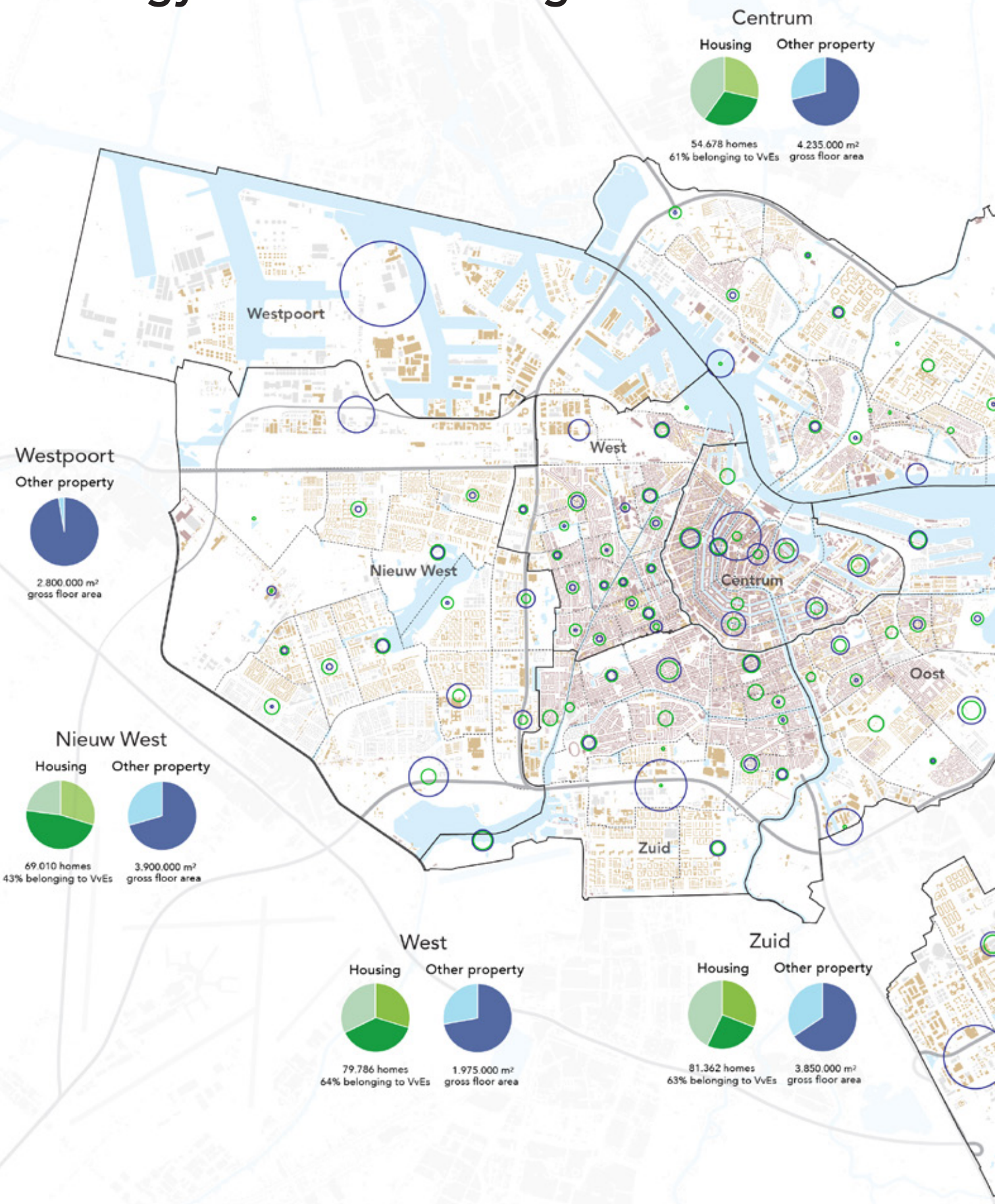
At present, fourteen offices/yards are natural gas-free, including the former district office on Plein 40-45 and the Amsterdam School building on Prins Hendrikkade. The district office in Oost is almost natural gas-free, and the district office in Zuid is 80% natural gas-free. In 2020, the district office on Buikslotermeerplein and our office on Klaprozenweg will become 100% natural gas-free. In 2020, natural gas-free alternatives will be sought for an additional three buildings that are used for municipal housing. The current office on Osdorpplein will be demolished and replaced with a natural gas-free development. If phasing out natural gas is not possible by 2030, we will investigate the alternatives, including the use of green gas or carbon-offsetting measures. When phasing out natural gas in our property portfolio, where possible we will coordinate with the district-based approach and the *Transitievisie Warmte*.

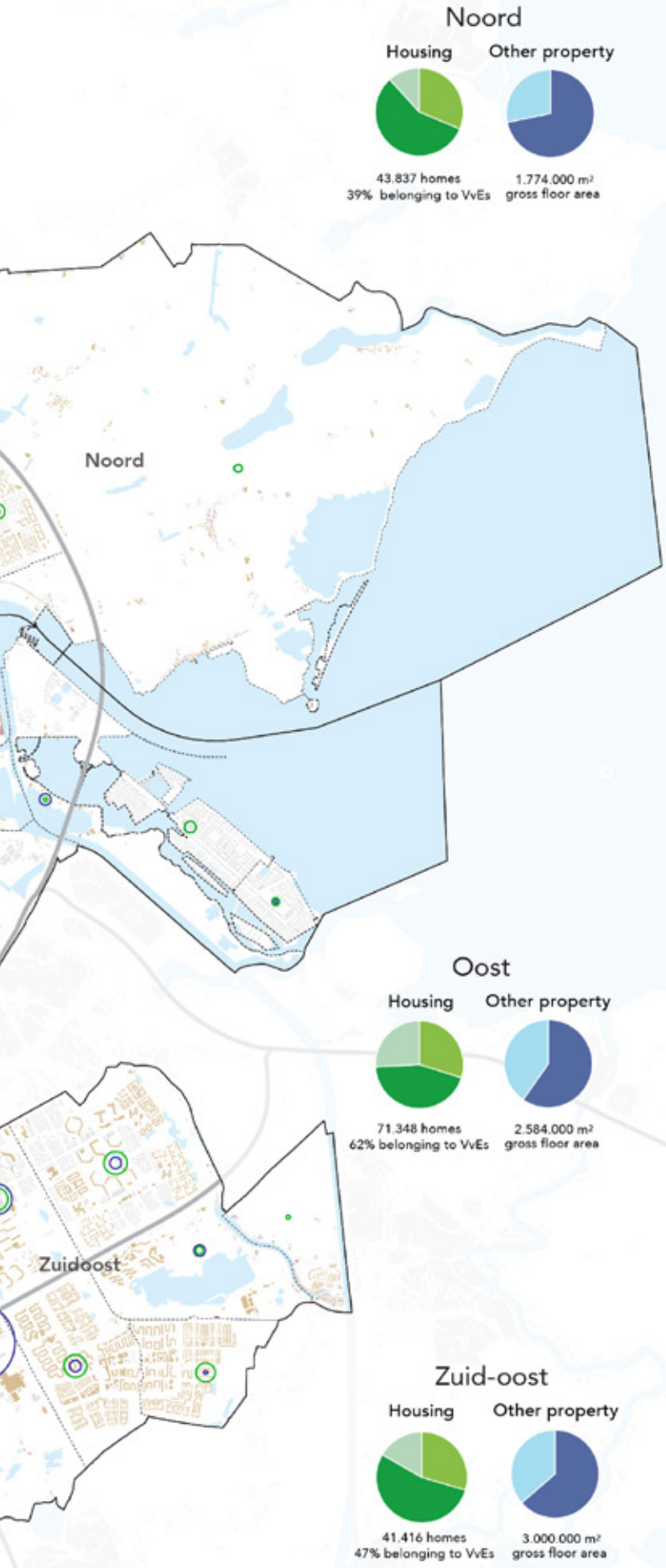
By 2030, all municipal swimming pools will be natural gas-free, and research will start on the renovation of the Mirandabad pool in 2020. The aim is to make the Mirandabad the first sub-tropical natural gas-free swimming pool. In 2020, we will also investigate how the Apollohal sports complex can be disconnected from the natural gas grid. Similar research has been launched for the Weeren sports complex.

The Built Environment

Energy-efficient buildings

Energy-efficient buildings





What does this map show?

Amsterdam has 441,000 homes and 24 million m² of gross floor area of economic activity, both businesses and social and civic institutions. The map shows the carbon emissions per district resulting from electricity and natural gas consumption in homes, companies and institutions, and provides an insight into the number of homes (owner-occupied homes, housing corporation rentals and private rentals) by district. Fifty-three per cent of all homes belong to an owner-occupier association (VvE). How these buildings are made energy-efficient is highly dependent on the type of building or home, the situation and the ownership ratio. Saving energy in social housing demands a different approach from that for owner-occupiers, regardless of whether they belong to a VvE. Different, specific approaches are also needed for commercial property and social and civic buildings.

Key

Year of construction

- before 1946
- 1946 -1991
- after 1991
- District border
- Neighbourhood border

CO_2 emissions caused by energy consumption (gas and electricity) per district (2017)

Housing

- 175 kt CO_2
- 35 kt CO_2

Other real estate

- 350 kt CO_2
- 175 kt CO_2
- 35 kt CO_2

Pie-chart key

Housing type

- Owner-occupied properties
- Social housing
- Private rental

Type of real estate

- Commercial real estate
- Social and civic real estate

3.1

Energy-efficient buildings

It is always good to save energy. We need to cut our consumption of electricity and heat, so that we can achieve a carbon-neutral built environment by 2050 and ensure that buildings are ready for the natural gas phase-out. That is because energy is scarce; certainly, renewable electricity and sustainable heat as an alternative to natural gas. The advantage is that energy-efficient buildings are often more comfortable and less expensive for residents and users. Companies that pay attention to energy consumption can reduce their costs and contribute to a climate-neutral Amsterdam. We are therefore ensuring that owners of all buildings in the city – homes, social and civic buildings and commercial buildings – take measures to avoid wastage.

What is the challenge?

Almost all of Amsterdam's buildings were built in an era when climate-neutral was not the norm. As a result, the built environment is responsible for a large share of Amsterdam's total carbon emissions: 25%, or 1,250 kt. Housing produces more than 50% of the carbon emissions in the built environment, due to the consumption of natural gas for heating, cooking and warm water. In this Roadmap, carbon emissions resulting from electricity usage are addressed in the chapter on Electricity (3.3). The rest of the carbon emissions come from buildings with a commercial function (20%), buildings with a social or civic function, and other buildings. It is always beneficial and essential to save energy in these buildings, regardless of how they are disconnected from natural gas at some point before 2040.

There are currently 442,000 homes in Amsterdam, 30% of which are owner-occupied, 42% owned by housing corporations, and 28% owned by private landlords. Fifty-three per cent of these belong to VvEs, and there are more than 21,000 VvEs in Amsterdam.

Amsterdam has 25,000 commercial buildings (45,000 addresses), with a total gross floor area of 17 million m2. Around 3,000 buildings (5,000 addresses) have a social or civic function. The municipality plays the role of owner, tenant or subsidy-provider, for example for primary schools, sports facilities, and arts and cultural facilities. The municipality does not have a formal role in relation to hospitals, universities of applied science or universities.

Pillar 4
Making housing energy-efficient

Pillar 5
Making the business market energy-efficient

Pillar 6
Making social and civic buildings energy-efficient

Research (OIS, 2019) shows that 75% of Amsterdam's citizens are positive about the switch to renewable energy, and are aware of the city's ambitions and approach to becoming natural gas-free. Many citizens are already saving energy; 78% of citizens use energy-saving or LED lightbulbs, for example. This is great, but we must do more. Measures that involve greater effort and investment are more uncommon.

Research also shows that 59% of all small to medium-sized enterprises (SMEs) in Noord-Holland want to take energy-efficiency measures within five years (Kantar, 2019). The majority are considering solar energy or energy-efficient lighting; fewer than a third are familiar with energy regulations or subsidy opportunities.

It is important, and in many cases also mandatory, for every property owner to take energy-saving measures. Such measures should be taken at logical times, such as during renovations, alterations or maintenance; but if possible, earlier is naturally better. In any case, the pace of making

buildings more energy-efficient must accelerate if we are to meet our target of becoming a climate-neutral city by 2050.

Pillar 4
Making housing energy-efficient

Pillar 5
Making the business market energy-efficient

Pillar 6
Making social and civic buildings energy-efficient

Pillar 4
Making housing energy-efficient

We are actively working to encourage homeowners to take energy-saving measures and install solar panels on roofs (for solar energy, see section 3.3 on 'Electricity'). On the one hand, this forms part of the large-scale district-based approach, whereby the natural gas phase-out is being combined with improvements to housing quality wherever possible. On the other hand, we are using instruments to help all property owners in the city to make their buildings more energy-efficient. This involves informing, stimulating, facilitating and reassuring. In Nieuw-West, Noord and Zuidoost, we are working on this task in 'development neighbourhoods' (*ontwikkelbuurten*). One of the five targets in development neighbourhoods is to improve the sustainability of homes, including phasing out natural gas for existing buildings and new-builds.

Stimulating by providing assistance: advice and assistance for homeowners

We are encouraging homeowners to make their homes energy-efficient by providing information and offering advice, assistance and financial instruments. We are focusing our efforts on VvEs. Since 2016, the municipality has been actively approaching VvEs and referring them to energy advice and decision-making support. Mixed VvEs (associations with a large owner, such as a housing corporation) can get support from !WOON. More than 1,000 VvEs, or around 40,000 homes, have already benefited from advice and support. In 2020, we will provide an online, step-by-step sustainability plan for VvEs, along with FAQs; this will help all VvEs to get started. We offer procedural support for larger and more complex VvEs, whereby every VvE has a green and sustainable multiannual maintenance plan at the very least by the end of the process. In 2020 and 2021, we want to support 700 VvEs (49,000 homes) actively in this way.

More than 1,000 VvEs, or around 40,000 homes, have already benefited from advice and support

People with questions about the natural gas phase-out, saving energy and sustainable generation can contact the municipality, !WOON, the Regionaal Energieloket (regional energy help-desk) or 02025, or come to one of the municipality's information evenings. Via the Regionaal Energieloket, homeowners can get technical advice, carry out house scans and request offers. The help-desk had more than 46,000 unique visitors in 2018. The Energiecoaches project helps citizens to use energy efficiently. 02025 is organising meetings for frontrunners who want to take sustainability measures with their neighbours or neighbourhoods, including the 'energy breakfast' and a technology consultation hour. In 2020, in cooperation with residents' groups, we will organise collective purchasing schemes in Nieuw-West for energy-saving measures and solar panels.

The Amsterdam Energy Loans scheme (*Amsterdamse Energielening*) offers owner-occupiers, VvEs, small landlords and tenants the possibility of borrowing money for energy-efficiency measures at very favourable rates. To date, c.10 million euros of energy loans have been extended to 1,800 homes, including 18 large VvEs. Most loans are for solar panels, insulating glazing and casings.

Agreements with parties that own a lot of housing in Amsterdam

With parties that own large amounts of housing in Amsterdam, we are making agreements on making these homes energy-efficient. For example, we have made agreements with housing corporations on reducing carbon emissions in their housing stock from 1.5% per year at present to at least 3% per year in 2023. They will achieve this by continuing with their measures to make housing more sustainable. In 2017 and 2018, the renovation of 20,000 housing corporation homes resulted in 45,260 energy-label upgrades. Agreements have also been made on more far-reaching cooperation to facilitate large solar projects on housing corporation roofs, and to disconnect homes from the natural gas grid, district by district. We want to make similar agreements with private landlords and institutional investors.

Energy-efficient behaviour by residents

Residents' behaviour is an essential part of reducing energy consumption. Not all residents are able to act, either because they are not owners or because they lack funds. Since 2016, energy coaches have been providing information about how to save energy, and helping residents to take simple energy-saving measures in their homes. By now, 11,000 homes have been visited by an energy coach, and this number will rise to 16,000 in 2020.

Legislation and regulations

We are investigating the longer-term options for using legislation and municipal powers to compel energy-efficient measures in homes, for both owner-occupiers and private landlords. We are also examining current regulations, for example on interventions in monuments and homes in conservation areas, in order to remove unnecessary obstacles (see also section 4.6 on 'Regulations').

In 2017 and 2018, the renovation of **20,000** housing corporation homes resulted in **45,260** energy-label upgrades

Actions and measures

- Offer energy advice to VvEs
- Intensify support for VvEs
- Offer energy advice to owner-occupiers
- Support energy-saving home improvements
- Organise collective purchasing schemes
- Continue Energy Loans scheme
- Make improvements to facades
- Implement agreements with housing corporations
- Make agreements with private landlords and institutional investors
- Deploy energy coaches
- Investigate energy-saving options in legislation and regulation

Pillar 5
Making the business market energy-efficient

This pillar concerns commercial buildings. These can be buildings that house SMEs, such as restaurants and shops, but also offices, shared office buildings and industrial buildings. Just like housing, energy-efficient measures will be needed for the buildings themselves, but we are also concerned with what happens in the buildings, i.e., the commercial processes that take

place there. The consumption of natural gas and heat in commercial buildings causes total carbon emissions of around 231 kt, or 4.6% of Amsterdam's total carbon emissions (2018). We should note, though, that the impact of commercial buildings in Amsterdam is greater than this, as they also emit CO_2 as a result of electricity consumption. This electricity consumption and associated carbon emissions form part of the Electricity transition path (section 3.3). The measures that are presented in this pillar focus on reducing heat and electricity consumption, however; on cutting carbon emissions as a whole.

In Amsterdam, there are many examples of businesses that are already sustainable, 100% carbon-neutral or even energy-positive. These inspiring frontrunners show how sustainability and entrepreneurship can go hand in hand, and even reinforce one another. In order to make the business market more sustainable, a movement needs to get started. We are aware that entrepreneurs need to be able to keep running their businesses, but this should be done in an increasingly sustainable way. We are taking a three-pronged approach:

1. The basis: informing and raising awareness
2. Supporting companies with sustainability ambitions
3. Regulating and enforcing

This will be achieved with a sector- or area-specific approach. When it comes to providing information and raising awareness, we see a role for organized business. Sector organisations, entrepreneurs' organisations (such as MKB Amsterdam), business investment zones and industrial sites are characterised by their collectiveness, which creates opportunities for more impact. We are thus seeking to coordinate with the district-based approach to phasing out natural gas, which is being developed for housing. Before the end of 2020, a programmatic approach will be agreed along the lines set out above, in consultation and cooperation with the business community. Where possible, of course, a parallel start has already been made on implementation.

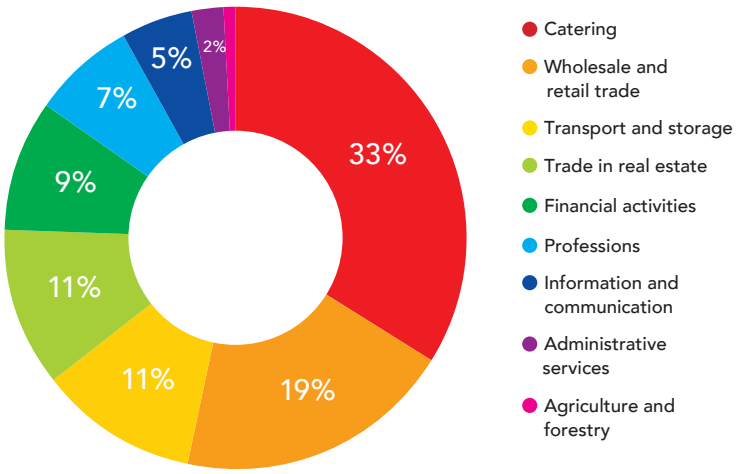
We are aware that entrepreneurs must be able to keep running their businesses, but they should do this in an increasingly sustainable way

1 The basis: informing and raising awareness

Research (Kantar, 2019) shows that many entrepreneurs in SMEs are not yet sufficiently aware of the relevant legislation and regulations, and opportunities for subsidies or financing. We are therefore going to do three things to improve the information position and raise awareness of sustainability.

First, the New Amsterdam Climate: an online platform for an offline sustainability movement. In addition to information for residents, this platform will set out all of the available information and assistance for businesses (see pillar 17). Second, we will work with the appropriate entrepreneurial channels in order to advise entrepreneurs and exchange best practices. This can include sector organisations, business investment zones, entrepreneurial organisations and business parks. The municipality will do this proactively, but the initiative can also come from the private sector. Third, we will work to improve the information position of the municipality and business community by improving our understanding of the specific

Natural gas consumption by business market sector (2018)



threats and opportunities for sectors and areas in Amsterdam. The aim is to use this understanding to make smart decisions, taking account of affordability, feasibility, implementation speed and the impact on the climate.

2 Supporting companies with sustainability ambitions

Support for companies that want to take (extra-legal) sustainability measures is currently rather incidental and reactive in nature. We offer companies that want to become more sustainable (external) energy advice, and also financing from the sustainability fund in some cases. We want to develop our supporting role in four ways.

First, by providing insight and individual advice and guidance. We are looking at how we can continue to provide and improve our existing (external) energy advice. Energy advice helps entrepreneurs to understand the threats and opportunities associated with energy savings and generation. Over the past five years, more than 700 free energy consultations have been held.

We will actively approach specific businesses, sectors or business parks with an offer of support

We see that almost 40% of the entrepreneurs that have on-site energy consultations also make investments in practice. That is a good start, but naturally we want more companies to invest. We want to continue to discuss this with entrepreneurs, for example by switching from an advisory role to that of energy coach, and thereby shifting the focus from advice to implementation.

Second, we will actively approach specific businesses, sectors or business parks with

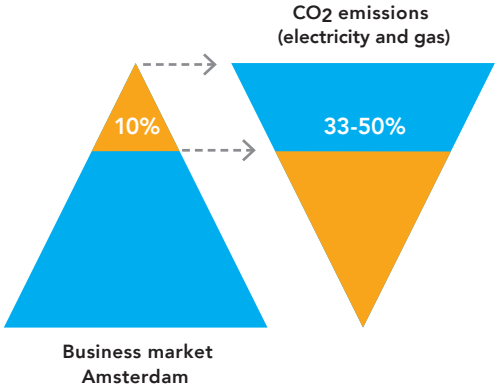
Businesses: legal obligations

General environmental rules (Environmental Management Act)
Enterprises and institutions that annually consume more than 50,000 kWh of electricity and/or more than 25,000 m³ of natural gas equivalents are obliged to take energy-saving measures with a return on investment period of five years or less. These are the measures on the Recognised Measures lists agreed by central government. Around 10% of Amsterdam's companies and institutions are subject to this energy-saving obligation in the Environmental Management Act. However, it is estimated that this group is responsible for 33-50% of carbon emissions from electricity and gas; see the figure below.

Information obligation for enterprises and institutions
Since July 2019, every institution that falls under the energy-saving obligation in the Environmental Management Act must periodically report on which energy-saving measures it has taken.

European Energy Directive (EED)
Large enterprises are obliged to undertake an energy audit every four years.

Office buildings are subject to the **(national) target** of complying with the quality standards for energy level label A by 2030, and are legally required to have label C in 2023. The Regional Agency for the Environment will enforce compliance from 2023. In the run-up to 2023, we will monitor developments and determine whether additional action is needed.



Circa 10% of companies in Amsterdam are legally obliged to save energy. However, it is estimated that these same companies are responsible for 33-50% of carbon emissions in the business market.

an offer of support. These include large, complex sustainability opportunities where the municipality can play an intensive, supporting role in order to achieve speed and progress. One example is the collective installation of solar panels in business parks and collective purchasing of energy advice. Naturally, we are receptive to project or pilot proposals from the market, whereby the municipality can follow a tailormade approach.

Third, we offer support in the form of financial facilities. We will continue to provide the subsidy for sustainable initiatives, and loans from the sustainability fund and the AKEF fund. We are exploring whether this will be sufficient to achieve our ambitions. For a large-scale roll-out, we will seek to coordinate with Invest-NL and the regional equivalent, Invest-MRA, which is in the process of being established.

Enterprises that consume a lot of energy must take measures to reduce consumption sharply

Finally, we are helping companies located in neighbourhoods where natural gas is being phased out, following the district-based approach. We are helping them to disconnect their buildings and operational management from the natural gas grid. For this purpose, we will seek to work with other entrepreneurs, commercial platforms such as business investment zones, entrepreneurs' associations and business parks, as well as (commercial) real estate owners. See also pillar 1 on the district-based approach to phasing out natural gas.

3 Regulating and enforcing

Amsterdam wants to accelerate the energy transition and must reverse the trend in carbon emissions. We will therefore intensify enforcement, and this will be done in a number of ways.

Datacentres: an example of a sector-oriented approach

Data play an essential role in society, and offer opportunities for accelerating sustainability in a smart and unrestricted way (see also pillar 19 on sustainable innovation). At the same time, growing data-use is also reflected in the rapid growth of the datacentre sector and the quantity of data equipment in datacentres, as well as in office buildings. Amsterdam's data sector is large and continues to grow. Datacentres, data equipment and data-use result in a high level of electricity consumption and thus have a major impact on Amsterdam's CO_2 emissions.

Datacentres therefore present a tough challenge when it comes to saving energy, but there are also opportunities. These are reflected in the Green Data Agenda, which will be drawn up in partnership with the business community and research institutes. The following will be addressed, among others:

- **Building expertise, monitoring and raising awareness about the carbon impact of data-use.**
- **Encouraging innovative technological solutions, such as power management, photonics, water cooling and virtualisation and the replacement of servers. A great example is the LEAP pilot project, where the Economic Board of Amsterdam and multiple stakeholders are working on more energy-efficient servers, among other things.**
- **More efficient use of waste heat from datacentres.**

Amsterdam will intensify enforcement of the energy performance of existing datacentres. At the same time, a location policy for new datacentres will be drawn up, in which selective growth in specific areas will be possible under certain conditions, including in relation to energy performance, use of green power and the smart use of waste heat.

We will take a tougher line on contraventions. The obligations in the Environmental Management Act have been in place for years. More recently, agreements have been made with most large consumers to introduce energy-saving measures. The municipality will ensure that the supervising bodies are able to carry out their tasks effectively. This will mean increasing the capacity of the Regional Agency for the Environment, among other things.

Enforcement will be driven by information. We want to act in a smarter and more focused way, and this requires having better information and oversight. One option is to use the data obtained via the obligation to provide information, for example by gaining insight into the degree to which businesses have taken (or not taken) certain measures. We can subsequently act on the basis of what will promote effectiveness and efficiency.

We will focus on optimising legislation and regulations. At present, most existing legislation applies to medium and large consumers (Environmental Management Act) and offices (energy label C in 2023 and label A in 2030). In addition, the current permit system is not always adequate, and it provides an unsatisfactory basis for taking (sometimes minimal) sustainability measures. We are going to explore the feasibility and desirability of expanding the existing legal frameworks, in order to create wider scope for application. In doing so, we will also consider the Environment and Planning Act (which comes into force on 1 January 2021) and the extent to which this new legislation offers starting points for the creation of new legal instruments at the local level to accelerate the greening of the business market. In doing so, we will focus on the competitiveness of Amsterdam's business community.

Finally, we will also take a tougher line on energy-neutral new buildings for businesses, offices and other commercial functions. When applying for an environmental permit for construction, businesses must satisfy the legal requirements, at a minimum.

The rate at which buildings are being made more energy-efficient is still too slow

In Amsterdam these will be made stricter in the coming years, and will ultimately become energy-neutral. Sustainability criteria will also play a role when allocating land to businesses through tenders or negotiations. Businesses will be challenged to deliver higher quality standards in relation to energy (see also pillar 7 on energy-neutral construction).

A sector-specific approach

The business market covers a large number of buildings, various sectors, areas, diverse business processes and a wide range of parties. Every sector has a different profile and faces its own, often very specific opportunities and threats. For example, the 'information and communication' sector (including datacentres) is characterised by extremely high levels of electricity consumption (see textbox on datacentres). By contrast, a sector such as catering is characterised by above-average gas consumption. This means that the extent to which the business market has already taken sustainability measures also differs significantly by sector. The aim is to respond smartly to the characteristics of each sector or field and to develop a more tailormade approach, as well as paying extra attention to specific themes or target groups, where necessary.

We will continue to refine this approach and apply it to the changing conditions and performance in the market. In doing so, we want to cooperate with the business community and utilise entrepreneurial channels, such as sector organisations, entrepreneurs' organisations, business investment zones and business parks.

Actions and measures

Provide information and assistance via the New Amsterdam Climate platform

Activate entrepreneurial channels, including MKB Amsterdam, the Chamber of Commerce, ORAM and business parks

Offer businesses energy scans, advice and guidance

Provide support for business sectors and/or business parks

Continue existing subsidy and loan schemes and explore expansion options

Assist businesses with the district-based approach to phasing out natural gas

Intensify enforcement of businesses that fall under the Environmental Management Act

Information-driven enforcement

Lobby for more ambitious legislation and regulations

Stricter sustainability criteria for new-builds

Establish a new location policy for datacentres

Draw up and implement Green Data Agenda

Every sector has its own opportunities and challenges

Pillar 6
Making social and civic buildings energy-efficient

This pillar concerns social and civic buildings in the city that are used every day by large numbers of citizens, such as schools, sports facilities, hospitals, theatres and concert halls. These public venues can play an exemplary role in the energy transition. As well as directly reducing a specific building's carbon emissions, making a social or civic building climate-neutral has added value because it serves as an example and provides inspiration, and thereby has a positive impact on people's behaviour. This can lead to even larger reductions in carbon emissions elsewhere, whether at home or at work.

There are around 3,000 social and civic buildings in Amsterdam, and they are extremely varied in terms of use, ownership and management. For example, there are social and civic buildings where the municipality plays a role as the owner, tenant or grant-provider, such as in the case of primary schools, sports facilities, and arts and cultural venues. It is with regard to these types of buildings that we have most influence on making buildings more sustainable.

When it comes to social and civic buildings owned by other (civil society) actors, such as hospitals, universities of applied science and universities, our influence is more limited and we play a different role. We can assist with drawing up sustainability plans and, if necessary, with organising, and sometimes financing, the implementation.

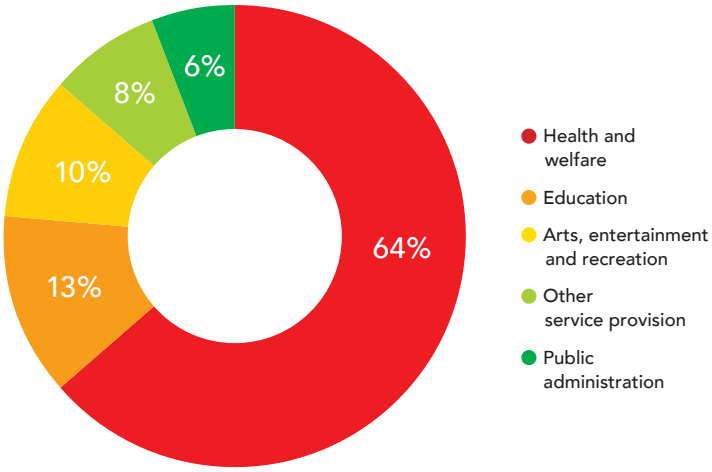
The efforts are already well underway. In recent years, we have gained experience and achieved successful results with

various target groups and diverse building types. The approach focuses on seizing opportunities and taking energy measures at the logical times, in cooperation with highly-motivated partners (see textbox on exemplary projects).

Acceleration approach for climate-neutral social and civic buildings

In order to build a better picture of all the current initiatives, and where necessary link them, we are launching an acceleration approach for climate-neutral social and civic buildings. With this approach, we want to steer more actively and provide support for social and civic buildings that is tailored to the target group and function of the building. The approach will be determined by the municipality's relationship with the building, owner or user. We are building on positive experiences in projects, whereby we are intensifying the municipal approach: taking a structured approach to working on all buildings and with all target groups. In addition, building owners and users – just like homeowners and commercial owners – are responsible for making their buildings climate-neutral. Every building owner must draw up a plan to reduce demand for heat and electricity and make this part of a long-term sustainability maintenance plan.

Natural gas consumption by sector, social and civic buildings (2018)



1993

Energy-saving obligation, Environmental Management Act

2015

Compulsory energy audit for large enterprises in European Energy Efficiency Directive (EED)

Incidental assistance for businesses that apply for it

2017

2017-2018
20,000 social housing homes improved with 45,260 energy label upgrades

2019

1000th VvE assisted with energy advice

10 million lent via the Amsterdam Energy Loan scheme for energy-saving measures in 1,800 homes, including 18 large VvEs

It makes sense to take measures at logical times, such as during maintenance and replacement, and to coordinate with the district- and neighbourhood-based approach to phasing out natural gas. An essential element of the programme is cooperation with educational actors, cultural institutions and sports institutions.

There are around **3,000** social and civic buildings in Amsterdam, varying substantially in terms of use, ownership and management

Actions and measures

Acceleration approach for climate-neutral social and civic buildings

Work towards energy label A for all municipal property in 2030

Implement energy-saving measures in school buildings

Cooperate to make arts and cultural buildings in the region more sustainable

Energy savings included in implementation agenda for the arts and cultural sector

Promote climate-neutral healthcare institutions: assistance where needed

Make agreements with large hospitals

Disconnect social and civic buildings from the natural gas grid

Replace lighting in sports complexes with LED lighting

What is at stake and what is our role?

Real-estate owners are increasingly prepared to invest in energy-saving measures. These measures often pay for themselves in a few years, but some have a longer return on investment period. Our approach is based on making every property-owner aware of the opportunities and helping them to make their buildings more sustainable. The aim is for property owners to take energy-saving measures at both independently-determined and logical moments. Where measures are legally required, we will enforce them.

2020

2020-2021
Support 700 VvEs a year with advice, online action plans and procedural guidance

Energy coaches visit 16,000 households, with tips and an energy box

Businesses obliged to provide information on energy consumption and energy-saving measures

Intensify enforcement of the Environmental Management Act and EED

Structural and active assistance for businesses (Business Market programme)

Corporations reduce annual carbon emissions from 1.5% in 2019 to at least 3% in 2023

2023

Compulsory energy label C for offices

Scale up assistance for homeowners

Agreements with private landlords

2030

Compulsory energy label A for offices

2040

All buildings natural gas-free

Where possible, we take regulatory action. Using the Environmental Management Act, we will compel enterprises and institutions to take energy-saving measures. From 2023, it will be mandatory for office buildings to have at least energy label C, and we will enforce this. This option does not exist for homes (yet), but we are investigating whether the municipality or central government could develop rules on this.

In our dealings with parties that own or use a lot of property, we will focus on cooperation. We have made agreements with housing corporations for the coming four years on reducing carbon emissions and collaborating to install solar panels on corporation roofs. We also want to make agreements with other large real estate actors and civil society institutions, such as hospitals.

When the municipality owns a building, we will take measures. We will make the right investments at the logical times (such as during maintenance and renovations); investments that result directly in an energy-neutral building, or in any case, a significant step in that direction.

From 2023, it will be mandatory for office buildings to have at least energy label C

This will only succeed if...

The rate at which buildings are being made more energy-efficient is still too slow. We are keen to accelerate the pace with a tougher set of instruments than those that we currently have. Sparking interest, providing the right expertise and supporting the various owners of buildings and businesses will only be effective if there is a sense of urgency to act. It is thus essential to heighten this sense of urgency, and this can be done with new or stricter laws and regulations, financial incentives, and by boosting knowledge.

Greening social and civic buildings: exemplary projects

With the Amsterdam Healthy School Buildings (*frisse scholen*) programme, we have already improved more than 100 (of 276) primary school buildings, by giving them a healthy interior climate and improving the buildings' energy ratings.

Renovations extend the life span of school buildings by 25 years, and we aim for at least energy label B. We ensure that the schools meet central government's 'healthy schools' requirements. If technically possible, the schools are even insulated to new-build level, which extends their life span by 40 years.

In recent years, various solar projects have been carried out in collaboration with the Amsterdam school boards. As a result, around 100 schools (of the 400 primary and secondary schools) now have solar panels. In Nieuw-West in 2019, 18 schools jointly installed 6,000 solar panels. This project is being copied with other school boards that are responsible for other school buildings.

Recently, more than 1 MW (3,500 solar panels) of solar energy was realised on sport facilities. A number of sports buildings are connected to the district heating grid and have sustainable installations. More than 60% of sports associations have invested in energy-saving measures. All swimming pools in the city must be natural gas-free and carbon-neutral by 2030.

In the cultural sector, many institutions are working on the sustainability of their buildings. The museums on Museumplein the Muziekgebouw aan 't IJ, the Bimhuis, Nationale Opera & Ballet, Meervaart Theater and Koninklijk Theater Carré have high-quality sustainability certificates. Various institutions, including the Muziekgebouw and the Hermitage, also have solar panels. The Hermitage also exchanges heat with the botanical garden, saving a considerable amount of energy.

For many homeowners, energy-saving measures are voluntary in nature. Unlike the business market, there are no legal obligations or regulations that can be used to compel energy savings. In addition, many homeowners have complex housing conditions, such as those who belong to owner-occupier associations (VvEs). The decision-making to which all measures are subject in VvEs is time-consuming, and often fails to result in action. In social housing, the pace of energy-saving measures can be increased if housing corporations are given more (financial) options; by abolishing the landlord levy, for example. Housing corporations have to contend with all kinds of ambitions and interests relating to building numbers and housing standards, through-flow, affordability and sustainability, but they have limited funds.

What applies to the housing market also partly applies to the business market. Some companies are subject to the Environmental Management Act and are therefore covered by energy legislation. The pace at which the business market and some social and civic properties take energy-saving measures is largely dependent on expertise and ambition. SMEs have only a limited knowledge of relevant legislation, such as the Environmental Management Act (research by Kantar, 2019). What is more, national legislation and regulations providing energy-saving measures for businesses and institutions lack the ambition and scope that Amsterdam needs to achieve its goals. We want to see more ambitious energy measures on the state's lists of mandatory measures, and we are investigating whether these could be applied to a larger share of businesses. This would increase the impact of the Environmental Management Act.

What are we going to do?

It goes without saying that the municipality will apply what we require from the city to our own buildings, and where possible, go even further. Municipal property consists of buildings for officials and municipal yards. These buildings must also be made sustainable, natural gas-free (before 2040) and climate-neutral (before 2030).

Of the 76 buildings and yards owned by the municipality, 14 are natural gas-free and 29 have energy label A. In 2020, plans will be drawn up for making the remaining buildings sustainable. When major renovations are carried out on a building, energy-saving measures will also be taken. We ensure that suitable roofs are used for solar panels (see section on Electricity). We also ensure that we comply with at least the minimum legal provisions in the Environmental Management Act and the energy standards for offices (label C in 2023, label A in 2030), and we go further where possible.

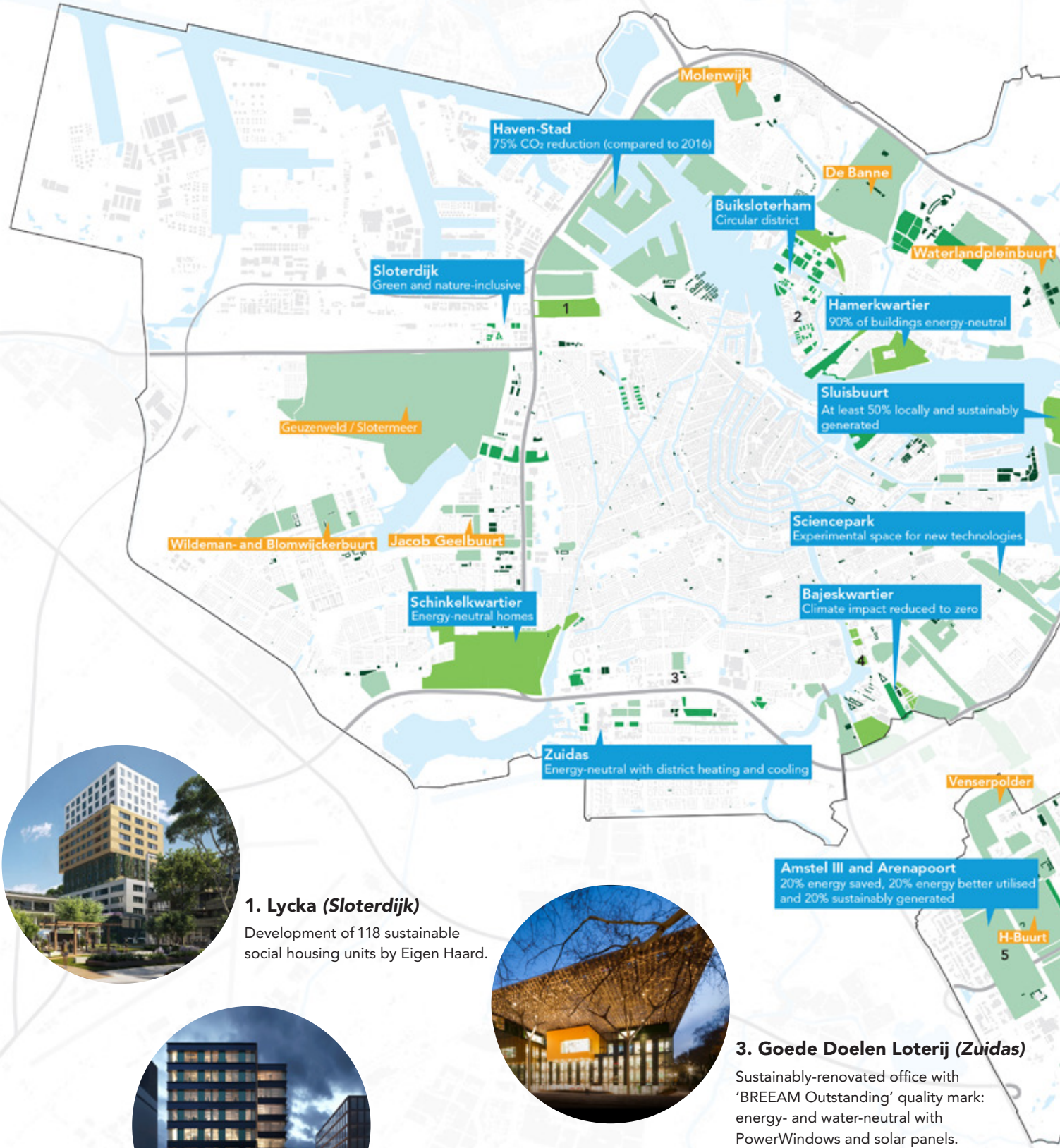
The transition plan for yards (*Transitieplan Werven*) will be put to Amsterdam City Council in 2020. The proposition is for a number of works sites to be closed down, renovated or rebuilt. Of the current 38 works sites, half will be closed and four will be rebuilt/renovated (on a large scale). Finally, two new transhipment sites will be developed in addition to the two that are currently under development. The new yards are almost carbon- and energy-neutral, and technically suitable for an emissions-free fleet. Between 2020 and 2024, all existing buildings will be brought up to energy label A standards.

Each year, we will ensure that 5-6 schools are renovated and made sustainable. The municipality sees opportunities to develop a business case for each school, to consider potential additional measures relating to flexibility and sustainability. We aim to do this for different kinds of buildings (new buildings, renovations, existing buildings), in order to gain extra experience. We will also take sustainability measures at municipally-owned swimming pools, gyms and sports complexes.

The Built Environment

Climate-neutral urban growth

Climate-neutral urban growth



1. Lycka *(Sloterdijk)*

Development of 118 sustainable social housing units by Eigen Haard.

2. Max & Moore *(Buiksloterham)*

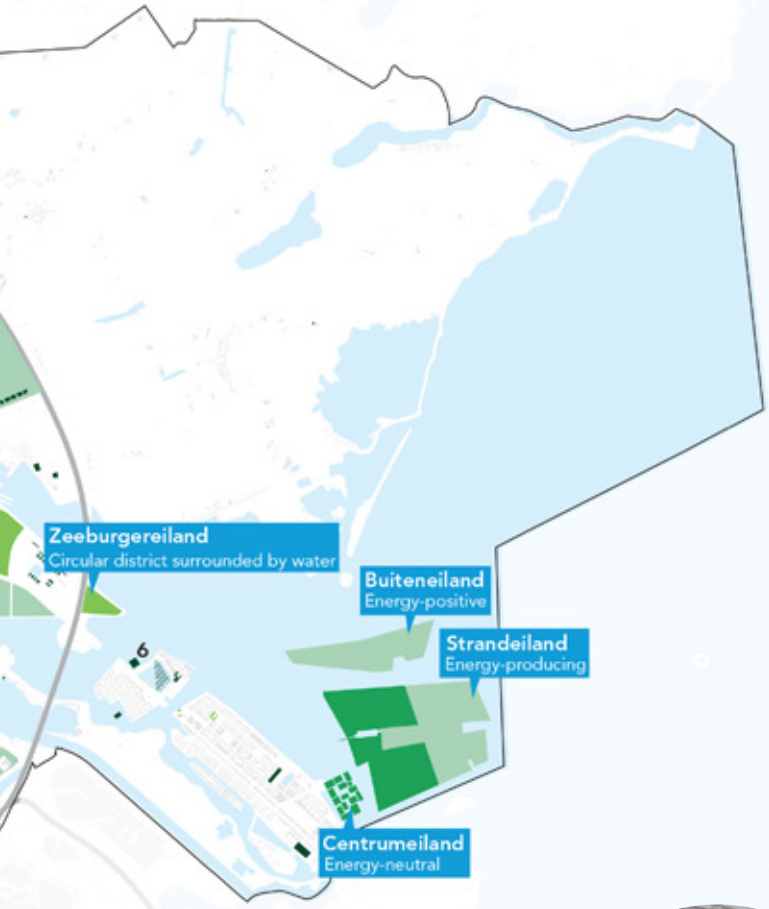
9.500 m² of office space powered by solar energy.

3. Goede Doelen Loterij *(Zuidas)*

Sustainably-renovated office with 'BREEAM Outstanding' quality mark: energy- and water-neutral with PowerWindows and solar panels.

What does this map show?

Amsterdam is growing. In future, more and more new buildings will be energy-neutral. We will thereby ensure that the city's growth does not add to the existing carbon-reduction challenge. The map shows the expected phasing and distribution over the city until 2050. It also shows the various types and sizes of new-builds and ground positions, from large-scale development areas and transformations to development and densification in existing neighbourhoods. We have highlighted a number of exemplary projects to showcase the great results that are being achieved in practice.

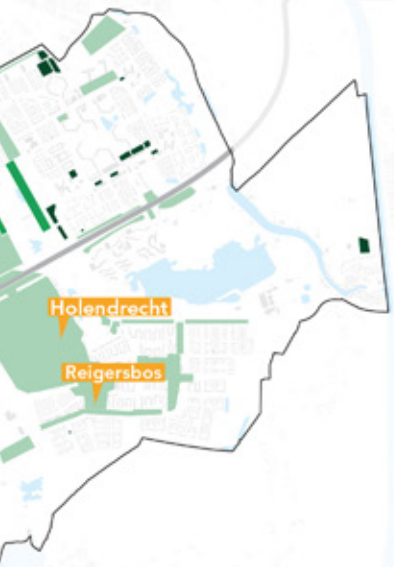


Key

- Existing urban area
- Development neighbourhoods
- Area development

Phasing future area development *(reference date May 2019)*

- < 2025
- 2025-2029
- 2030-2040
- > 2040 or unknown



5. SPOT *(Zuidoost)*
Sustainable mixed residential and work area.

6. Sluishuis *(IJburg)*
380 energy-neutral apartments.

4. HAUT *(Amstelkwartier)*
The tallest wooden skyscraper in Amsterdam, with 21 floors.

3.1

Climate-neutral urban growth

There is just one moment to ensure that the city's new buildings are of a sufficiently high quality, and that is when they are built. The task of reducing the city's existing carbon emissions is already great enough; we must not add to it with new buildings or public spaces. We will continue to follow Amsterdam's policy on energy-neutral construction. At present, we are still one step ahead of what is required by national legislation. In future, only energy-neutral construction methods will be used (well-insulated, fitted with solar panels and connected to a sustainable heat source). Wherever possible, the market will be challenged to deliver energy-producing buildings. A contribution will also be made during the construction phase, by using emissions-free building materials and emissions-free delivery and removal of building material.

What is the challenge?

Since 2010, Amsterdam's population has been growing by c. 10,000 people every year. The ambition is for the number of homes in the city to rise in the coming years by c. 7,500 homes per year, to 511,000 homes in 2030. The number of jobs has grown even faster than the number of residents. In addition to many new homes, this will result in the construction of new office and commercial buildings in the coming years.

New-builds come in various kinds and sizes. They can be large-scale area developments, such as in IJburg, Zeeburgereiland or the Zuidas. Existing Amsterdam neighbourhoods are also becoming denser, however, due to the addition of new buildings. Most of the city's growth takes the form of large-scale area transformation. Transformation involves existing business and industrial areas that are changed into mixed residential and work areas, such as Buiksloterham or the Hamerkwartier in Noord, Amstelstad in Zuidoost or Haven-Stad.

Buildings in new-build areas and transformation areas (homes, offices, commercial and social and civic property) will be very energy efficient, energy-neutral or even energy-producing. An energy-neutral house generates of all the building-related energy it consumes itself (and/or receives renewable energy from a grid), and uses no fossil fuels in the process. In new-build or transformation areas, this not only presents challenges at the building level, but also in public space and under the ground.

Pillar 7
Energy-neutral construction

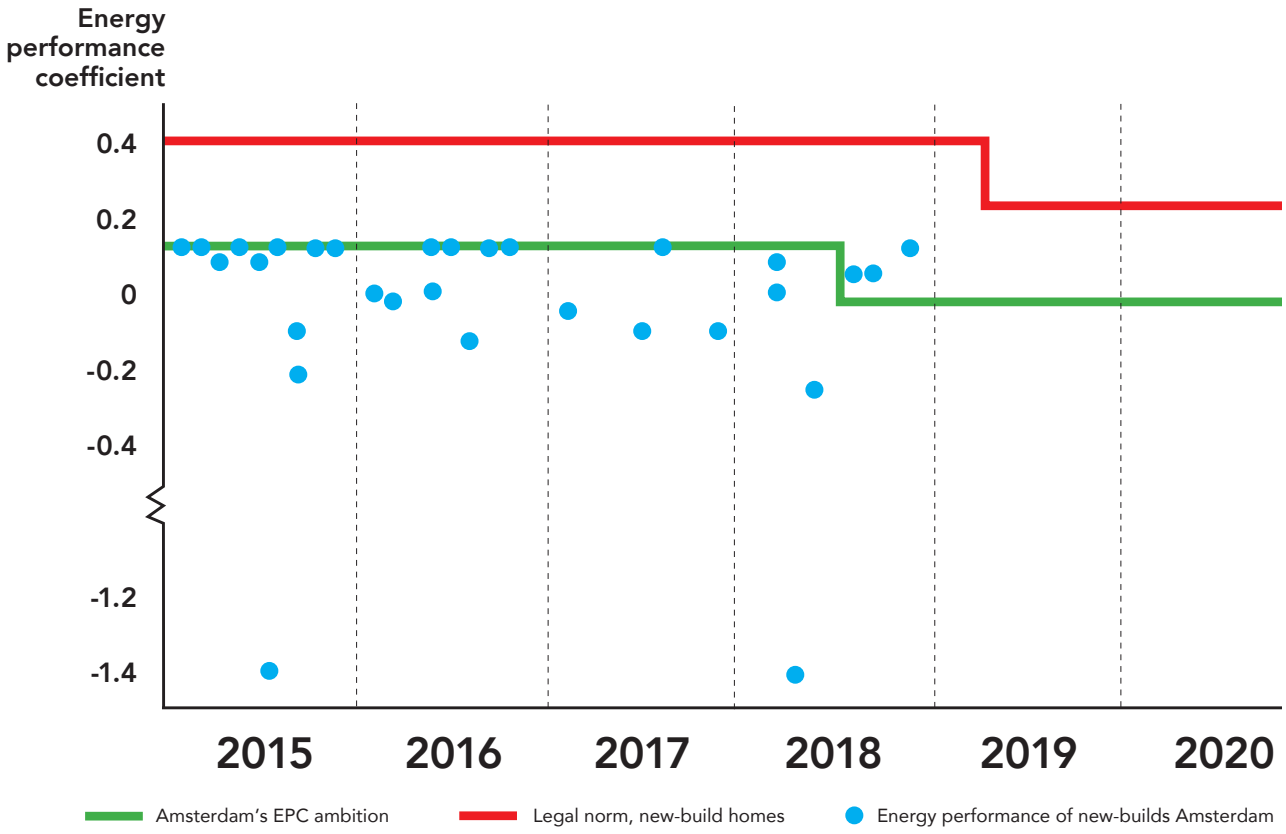
Pillar 7 Energy-neutral construction

For many years, we have had an energy-neutral construction ambition (EPC ≤ 0.15) that challenges the market using land allocation tenders. Our set of instruments was expanded in Amsterdam in 2019, meaning that we can now set standards for energy-neutral construction using environmental permits. In the coming period, we will continue to use both approaches.

We are developing standards for energy-neutral buildings and making these mandatory for all new buildings, using the environmental permit system. This line was taken in early 2019 with the aid of the Crisis and Recovery Act (*Crisis- en herstelwet*), which sets a stricter EPC standard for new-build homes (EPC ≤ 0.2), and this

The energy performance of new-builds in Amsterdam

Amsterdam has a long history of tendering new-build land. Practice shows that although this is challenging, it produces great results. In recent years, we have even seen the development of energy-producing buildings. The number of new-builds that come to the market via tenders is falling, however, and we are increasingly seeing transformation projects on land that is not owned by the municipality. Since 2019, we have therefore followed a broader strategy that uses environmental permits to set ambitious targets for the energy performance of new-build homes. This strategy will be tightened in the coming years, and expanded to cover functions other than housing.



line will be continued. In the coming years, standards for energy-neutral construction in Amsterdam will be tightened gradually and expanded to cover other use functions, such as offices, hotels, and other commercial and social/civic real estate. The aim is for energy-neutral construction to apply to all use functions, and for appropriate preconditions to be created for this purpose. The continued development of standards in Amsterdam for building energy performance and an appropriate financial system and preconditions will be elaborated further in 2020, after which a decision on implementation will be taken at the administrative level. The building regulations and (later) the Environmental Plan provide public law instruments for regulating standards in Amsterdam using environmental permits.

Amsterdam is developing standards for energy-neutral construction

By means of land allocation and ground lease negotiations, we will continue to challenge all developers to deliver improved energy performance: from very energy-efficient to energy-producing buildings. This approach will be effective when using tenders to bring new-build land to the market, but the situation is more complex when negotiations are held on existing ground lease contracts. Amsterdam has a long history in sustainable tendering;

practice shows that this is challenging, but that fantastic results can nevertheless be achieved. In recent years, this has even led to several buildings that will be energy-producing.

In addition, we are encouraging innovation at the area level. One example is the EU ATELIER project, where we are cooperating with thirty international partners to build an energy-producing district in Buiksloterham and a district in Bilbao, Spain. We are also working hard on innovation in energy systems in districts such as Amstel III and Strandeiland, for example by using heat from the sewers. We will continue with this area-based approach.

We boost the innovative power of the market by constantly taking a more ambitious approach than that proscribed by central government. Learning and innovation is taking place in practice in Amsterdam, and the market will subsequently scale up. In this way, we will ensure that carbon emissions do not rise in the growing city.

New-builds in Amsterdam are often already energy-efficient

Actions and measures

Research further tightening of energy-neutral construction standards for Amsterdam

Develop monitoring indicators and system for energy-neutral construction

Intensify enforcement and supervision of construction sites

Continue mandatory standard (EPC ≤ 0.2) for new-build homes using BENG system

Legally guarantee mandatory standards for energy-neutral construction of new-build homes, offices and other functions in Amsterdam

Evaluate Amsterdam's policy on energy-neutral construction

Use land allocation tenders to challenge market to build energy-neutral or energy-producing buildings

2015

Municipal ambition: EPC ≤ 0.15 for 75% of all new buildings. Tenders for new-build land used to challenge the market

2018

Municipal ambition (coalition agreement): set extra-legal standards for building energy performance and challenge market to build energy-producing buildings

National legislation: all new buildings natural gas-free

2019

2019-2020 Compulsory standard in Amsterdam: EPC≤ 0.2 for new-build homes. Applies to everyone through environmental permits

Zero-rate environmental permit for sustainable renovation

Subsidies for sustainable self-construction

Implement EU ATELIER project

Share knowledge for innovation and scale up

Every construction company will be asked to take steps to build new buildings that are energy-neutral and, where possible, energy-producing

What is at stake and what is our role?

Ground positions differ according to the situation. Some land is owned by the municipality, and we use tenders to put it on the market and lease it out; other land is privately owned. Transformation can involve an existing ground position and a ground lease contract that has to be adjusted in order to facilitate new buildings or renovations.

In most cases, the municipality is not the developer or owner of new buildings or buildings undergoing renovation. Such cases require all developers in the city to play their part. Every builder will be asked to take steps to deliver new buildings that are energy-neutral, and where possible energy-producing. By taking a tailormade approach at the local level, we can capitalise on the opportunities created by national legislation and regulations. Our objective is to spur innovation in the market.

2020

Research tightening Amsterdam's standards for energy-neutral buildings for new-build homes, offices and other functions, appropriate financial systems and the right preconditions

2021

New national legislation for 'almost energy-neutral buildings' (BENG)

Minimum Amsterdam standard: EPC $\leq$ 0.2 for new-build homes continued and translated into Amsterdam BENG standard (e.g., stricter insulation values and sustainable generation). Applies to everyone with environmental permit (via building regulations or Environmental Plan)

2022

Tightening of mandatory Amsterdam standards for energy-neutral buildings for new-build homes and offices. Applies to everyone with environmental permit (via building regulations or Environmental Plan)

2023

Expansion of mandatory Amsterdam standards on energy-neutral buildings for other use functions. Applies to everyone with environmental permit (via building regulations or Environmental Plan)

2025

Evaluation of Amsterdam policy on energy-neutral construction

Project in the spotlight

A smart system for Schoonschip

They are the most sustainable water-homes in Europe: the Schoonschip project's floating residential neighbourhood in the Buiksloterham district. Thirty water-homes exchange electricity in a private network, thanks in part to the smart grid provided by system & platform integrator Spectral. Spectral is also one of the thirty international partners in the EU ATELIER project, which is building an energy-producing district in Buiksloterham.

"Schoonschip is a community of likeminded people: 47 households that want to live on the water as sustainably as possible", explains commercial director Tom Westra. "Spectral was commissioned to make the community as self-sufficient as possible."

"First we looked at the anticipated energy needs and the storage. There was no room for centralised storage the size of a container, so we developed a home-based battery for all of the homes."

The main challenge, according to Tom, was peak demand. "If it's -10 degrees outside in the morning and all thirty homes start up their heat pumps simultaneously, you get peak demand. In order to counter extreme peaks such as these, Spectral worked with the Fraunhofer ITWM research institute to create a highly advanced smart microgrid platform. This software treats all the batteries as a single neighbourhood battery, can see where there are surpluses and deficits, and exchanges electricity between them. By setting off the peaks ourselves, storing electricity and distributing it smartly, we need much less power from the public grid."

"As a result, Schoonschip is supplying energy to its own community. Normally this role would be played by an energy company; that's why an exemption has been requested. The technology is there, but the regulations have yet to catch up. Fortunately, Amsterdam wants to be a frontrunner, and is seeking flexible ways to make exceptions for experiments like this – fantastic! And bravo to the frontrunners: technology is one thing, but above all, you need people who are prepared to put their necks on the line. With this project, we're showing that it *can* be done."

Developers need an environmental permit for construction from the municipality. This permit sets a higher quality standard than that proscribed in national legislation. We are continuing to challenge parties, including via land grants, to deliver buildings with even better energy performance.

This will only succeed if...

We are conducting research on the specification of new Amsterdam standards for energy-neutral construction, and the implications this will have for carbon emissions, costs, spatial quality, other (sustainability) ambitions and feasibility. This will be a particular challenge for high-rise buildings with relatively little roof surface for solar panels. Energy-neutral construction will also require a new approach to architecture, one that uses less glass and facilitates solar panels on facades.

We have been taking steps towards energy-neutral growth for years. Some time ago, the Houthavens district was identified as an excellent area for 'almost energy-neutral construction'. As a result, homes have been built to almost-energy-neutral standards in recent years. More recently, targets have also been set for Centrumeiland (2015) and Haven-Stad (development strategy 2017). We have also achieved good results with tenders for new-build land, which has even led to energy-producing buildings. The challenge will be to anchor 'climate-neutral' as the leading principle in all area-based development in the coming period. This task also relates to energy networks and area-based energy exchange.

In order to reverse the trend and reduce carbon emissions, we need steps that apply to everyone, regardless of the function or owner of a building. That is why we have decided to take the public legal route and establish standards that apply to all. Together with the other requirements and targets for new buildings in Amsterdam, better energy performance will lead to higher building costs. Although these costs are earned back later by the building's residents or users, this is perceived by project developers and housing corporations as an accumulation of ambitions that obstructs implementation. This picture is not confirmed by the figures on home-building production and tenders. If we raise the ambition level and apply it to everyone, though, we will face challenges developing a suitable financial system and preconditions for social housing, social and civic buildings, high-rise buildings and transformation projects, among others.

The construction of local heat distribution grids in new-build and transformation areas is relatively new

We have decades of experience with building electricity and gas networks. In order to facilitate the desired growth and sustainability of the city, the electricity grid must be reinforced and smart storage solutions must be found. This is a task for the whole city. The construction of local heat distribution grids in new-build and transformation areas is relatively new. This means that we will need to pay more attention to the system of area-based development and furthering the municipality's coordinating role.


HELLO SUNSHINE
SUNSERVITY

Djian Sadadou

Expat and solar energy specialist at Sungevity

"When I was growing up in Latin America, I witnessed at first hand the negative effects of climate change, such as water shortages and air pollution. I've also seen how important it is to have a fair and socially-inclusive transition to a sustainable world. Sustainability is an international issue and CO_2 knows no borders. But there are great differences between countries, groups and cultures."

"In Amsterdam, too, there are differences between people and their sustainability options. The municipality must try to iron out these differences as much as possible. For example, there are several projects where people who don't have usable roofs can buy or hire solar panels cheaply. But the municipality could do even more. There are a number of places, in Amsterdam Noord for example, where there is still space for more solar panels. Then you could make it possible for everyone to have solar energy."

"When I take the train, it's fantastic to see all the solar panels everywhere. It's like a sustainable movement that you see spreading out further and further."

"At the moment, if you don't own a roof, it can be a tricky process to get solar panels. You have to do a lot of research, and share the solar energy that's produced fairly. My building doesn't have any solar panels. I think it's the owner's responsibility to arrange this."

"Through my work at Sungevity, I notice how enthusiastic people are about their solar panels. It's also an easy way to get to know more about other aspects of sustainability. It's cool to have solar panels. You produce your own energy, they ultimately pay for themselves, and you're helping the climate."

Mobility

3.2

Mobility

Amsterdam is attracting increasing numbers of residents, visitors and jobs. More people means more journeys: by road, rail, water, and also by air. The city is growing, too, meaning that the distances travelled are also getting longer. This has implications for the pressure on our surroundings, and if we do nothing, it will lead to more carbon emissions. By encouraging, facilitating and where necessary regulating the transition to sustainable transport, we are working to achieve fewer and cleaner vehicle kilometres. This transition path is specifically about the carbon emissions of passenger and goods transport in Amsterdam, and the aim is to minimise the number of polluting kilometres. We want to limit the growth in polluting vehicle kilometres in Amsterdam by switching to different, more sustainable forms of transport. We will ensure that the traffic that remains is clean. This will not only help to make Amsterdam cleaner and more peaceful, but it will also make the city more attractive and liveable for everyone.

What is the challenge?

The main goal is to minimise the number of polluting kilometres travelled, in order to reduce carbon emissions from transport in Amsterdam. In addition, we are striving for all traffic within the built-up area to be emissions-free by 2030.

Motorised transport in Amsterdam causes 18% of total carbon emissions; reducing this will be a significant challenge. Half of all transport emissions come from traffic on municipal roads. The rest is composed of emissions from recreational boats, ferries, and traffic on the A10 motorway and provincial roads. Although the municipality has no influence over these regional roads, which are the responsibility of other authorities, the measures taken by Amsterdam will have a cascade effect.

Passenger cars, delivery trucks and taxis are responsible for 95% of the vehicle kilometres in the city and cause 84% of carbon emissions from transport. Medium-sized and heavy goods transport is responsible for just 5% of kilometres travelled, but emits the most carbon per kilometre.

Mobility

CO_2 emissions

870 kt

Share of total CO_2 emissions

18%

Emissions from international aviation and shipping are not counted among Amsterdam's emissions; emissions from recreational boats, cruises, river transport and ferries are, and these emit 36 kt of CO_2 every year.

More and more citizens are opting to cycle or use public transport: 70% of personal journeys to, from and within Amsterdam are made by walking, cycling or with public transport, and are therefore sustainable. This tends to be the smart and healthy option in the city. Despite the city's strong growth in terms of residents and employment, the number of car journeys in the city has even fallen slightly in recent years. On balance, CO_2 emissions from transport have remained roughly the same since 1990. The task is to reduce the number of polluting journeys further.

At the same time, the car will remain an important form of transport for many citizens, visitors and commuters from outside the city. Most cars are still powered by fossil fuels, as are most buses and lorry traffic in the city. For the 30% of journeys that are still made by car, we are therefore aiming for less, smarter and above all clean transport. Amsterdam is a world leader when it

CO_2 emissions resulting from fuel consumption

Amsterdam's roads	Motorways	Mobile machinery	Ferries, recreational boats and diesel trains	Other greenhouse gases
431 kt (50%)	**307** kt (35%)	**98** kt (11%)	**8** kt (1%)	**31** kt (4%)

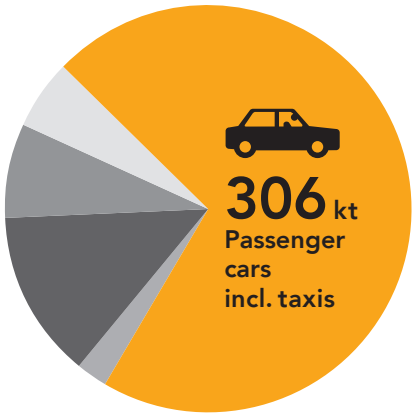
Emissions on Amsterdam's roads per vehicle category (kt CO_2 2017)

Public bus and coach transport: 24 kt

Trucks: 33 kt

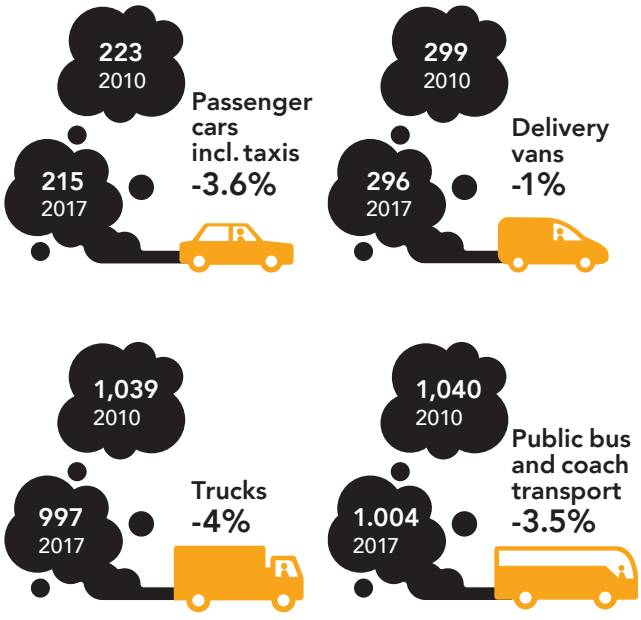
Delivery vans: 57 kt

Motorbikes, mopeds and motorised bicycles: 10 kt



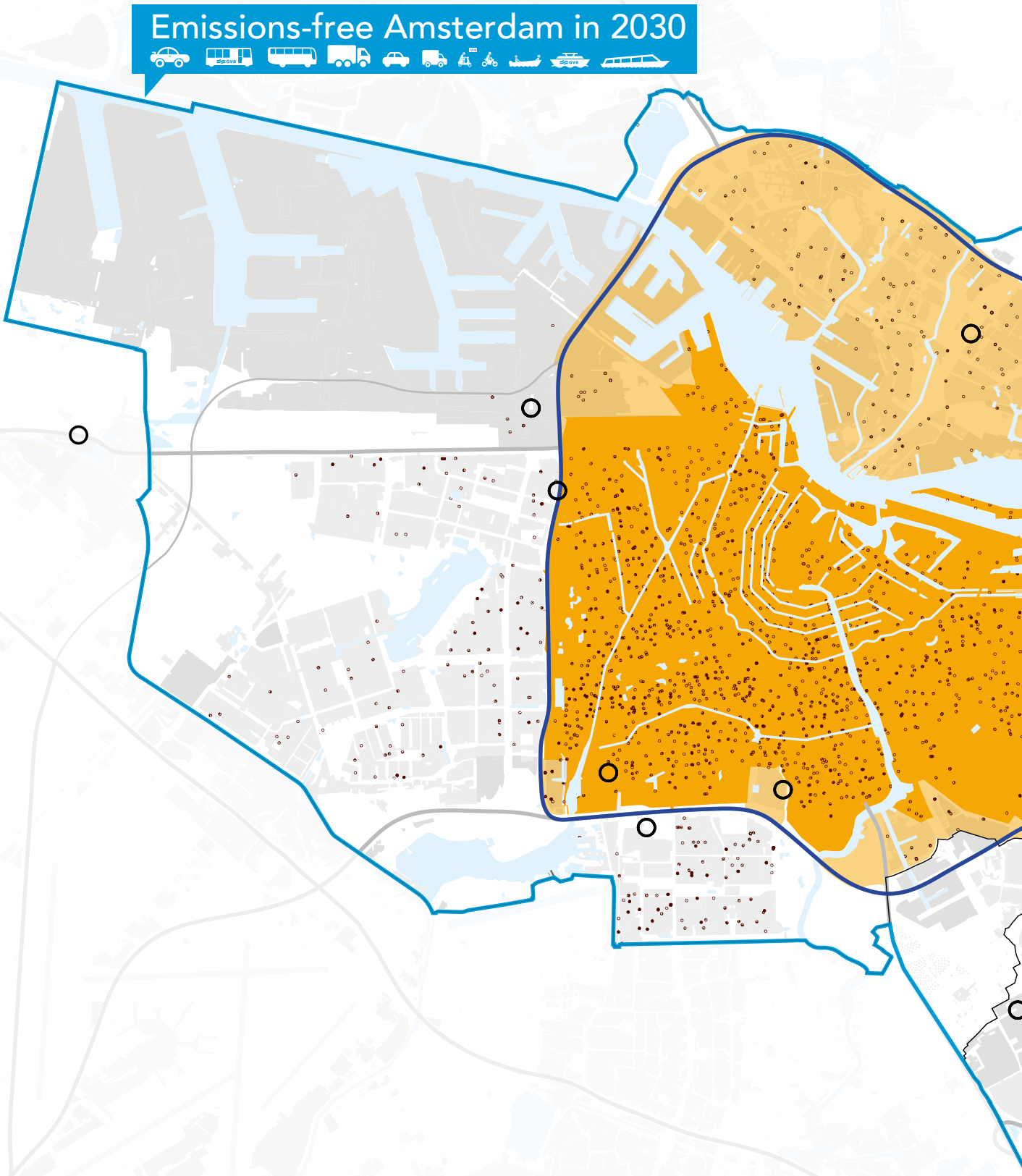
CO_2 emissions per vehicle type

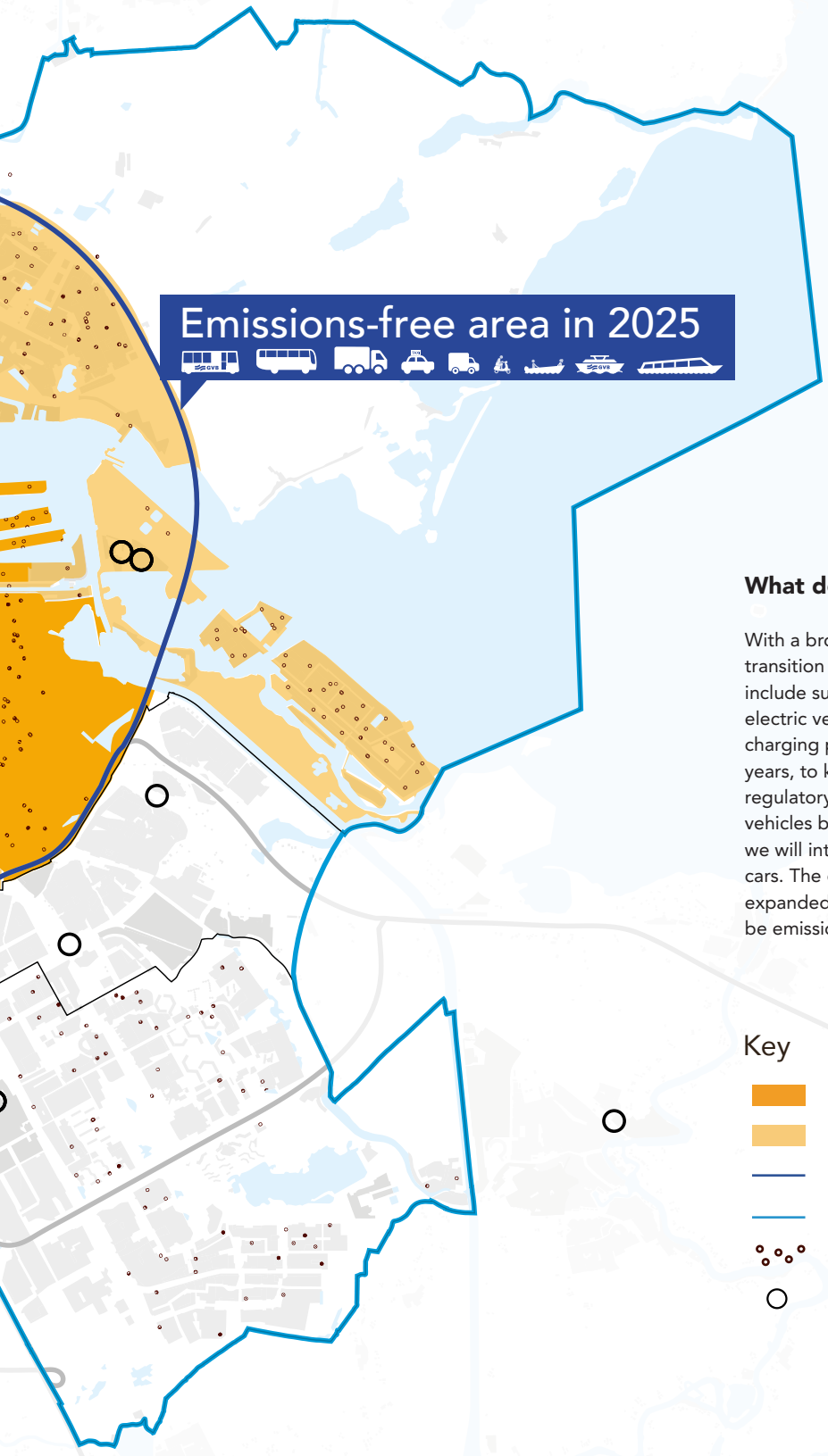
(gr per km)



Number of electric cars owned by citizens	Number of electric busses in Amsterdam	Number of electric taxis in Amsterdam	70% of journeys sustainable in 2017
From 22 in 2010 **to 5,014** in 2017	**10** in 2018	**From 250** in 2015 **to 943** in 2018	

Mobility





What does this map show?

With a broad package of measures, we will ensure that the transition to sustainable transport gets started. Examples include subsidies for green vehicles and the facilitation of electric vehicles with a demand-driven rollout of public charging points. We will expand this network in the coming years, to keep pace with the number of electric vehicles. As a regulatory authority, we will put limits on fossil-fuel-powered vehicles by using environmental zones, for example. In 2020, we will introduce a new environmental zone for passenger cars. The other environmental zones will be made stricter and expanded. By 2030, all traffic within the built-up area should be emissions-free.

Key

- Current environmental zone
- Potential expansion of environmental zone
- Emissions-free area within A10 (2025)
- Emissions-free Amsterdam (2030)
- Existing public charging points for electric cars
- P&R locations

comes to facilitating electric transport, and we are setting an example for many large cities.

The transition to clean transport remains a considerable challenge. Of the 200,000 passenger cars that enter the area within the ring road every day, only 3% are currently electric. Of the 800 coaches, 1% are electric, and the figure for the 50,000 scooters is 5%. Lease companies, car-sharers, the removals trade and the taxi industry are all further ahead in the transition.

Seventy-six per cent of professional passenger boats on the canals are already emissions-free. For all recreational boats, this figure is less than 5%. We expect to see the first emissions-free ferries operating in 2022. The approach to river transport is still in its infancy.

The national government is working on the options to reduce carbon emissions from aircraft, trains and ocean shipping. Amsterdam is following these developments closely and trying to accelerate them where possible. From a climate perspective, Schiphol Airport can only grow if aviation is made more sustainable.

The measures we describe in this chapter form part of current programmes, including the programme to limit car traffic (*Amsterdam Autoluw*, October 2019), the *Clean Air Action Plan* (October 2019) and the programmes on water transport (*Varen*), *Smart Mobility*, and clean bus transport (*Zero Emissie Bus*). This Roadmap summarises the measures that are being taken to contribute to a climate-neutral city.

The measures to reduce the number of polluting kilometres in Amsterdam fall under two pillars, which form the core of our strategy:

Pillar 8
Limiting polluting traffic

Pillar 9
Greening all polluting vehicles and vessels

Pillar 8
Limiting polluting traffic

Pillar 9
Greening all polluting vehicles and vessels

Pillar 8
Limiting polluting traffic

For many years, we have been working to reduce and green vehicles in the city, and encouraging people to walk, cycle and use public transport. Among other things, the measures in this pillar will be approached programmatically in the multi-annual cycling plan (*Meerjarenplan Fiets*), the plan to limit car traffic (*Agenda Autoluw*), and the *Smart Mobility* programme. This pillar contains a concise summary of the approach.

Boosting cycling

The multi-annual cycling plan contains measures to ensure that we keep cycling in Amsterdam. The plan is based on three objectives: comfortable cycling networks, convenient bicycle parking and new cycling norms ('*nieuwe fietsen*'). 'Comfortable cycling networks' entails various measures to improve the quality of the cycling network. Routes will be widened and intersections redesigned, and more attractive and peaceful cycling routes will be introduced, known as the *Groennet* ('green network'). 'Convenient bicycle parking' entails measures to ensure sufficient bicycle parking opportunities. New-builds and redesigned public space will be subject to requirements for bicycle parking facilities. Third, campaigns and measures will make cyclists aware of different, safer behaviour. The municipality is promoting cycling in Nieuw-West, Noord and Zuidoost.

Limiting the number of cars in the city

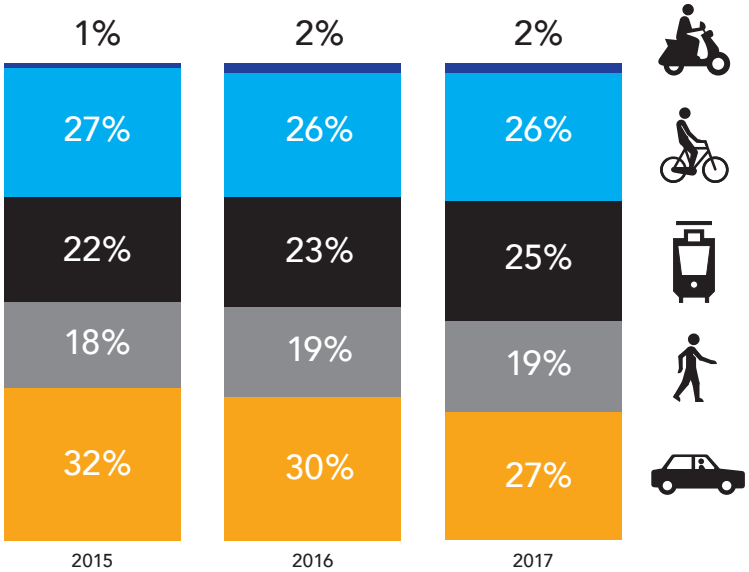
The action plan on limiting cars in the city (*Agenda Amsterdam Autoluw*) emphasises the creation of more space for cyclists, pedestrians and public transport, and more space for facilities and accommoda-

tion. In order to create this, we will reduce the amount of space occupied by moving and parked cars. One important measure will be to reduce the number of parking permits in the city. In addition, the action plan announces a number of proposals on circulation, which is intended to lead to a fall in local traffic. The action plan encourages citizens and visitors to opt increasingly for alternative, greener forms of transport, such as cycling and public transport.

In addition, we want to make optimal use of the limited public space. The *Agenda Amsterdam Autoluw* contains 27 measures. In addition to the measures mentioned above, the plan considers more and affordable public transport, and more options for sharing cars and other forms of transport. It also considers reducing car journeys by using smart logistics, and a pilot with barriers to create car-free streets. In order to reduce the number of (local) polluting kilometres, we have raised parking charges (since April 2019) and are cutting the number of parking spaces. Cars are literally being given less space, which is creating space for other functions at the local level.

With a smarter transport system, we can also ensure a reduction in the number of polluting kilometres in the city

Modal split journeys in Amsterdam



Before 2040, we will introduce various types of low-traffic areas, such as those in new Amsterdam city districts (Haven-Stad, IJburg-2), streets such as Ceintuurbaan and Kinkerstraat, the city centre, Amsterdam's canals and (mixed) residential neighbourhoods. These low-traffic areas will increasingly converge. Limiting car traffic, however, is not simply a matter of banning cars from the city. The creation of low-traffic areas means that traffic will be more concentrated on the main thoroughfares, where good flow-through is essential for the accessibility of the city.

This policy will ensure that there is no rise in polluting kilometres, despite the growth of mobility in the city. It is our aim to prevent carbon emissions from traffic from growing in the coming years, and to reduce them for a number of vehicle categories.

Smarter organisation of transport

The smarter organisation of transport will also lead to a fall in the number of polluting kilometres in the city. In the Smart Mobility programme, the municipality is developing a future transport system in partnership with residents, visitors, public and private parties. For example, the provisioning of the city can be made cheaper and more efficient by combining goods deliveries. We are using well-located logistical hubs to encourage lorries to transfer goods to electric delivery vans or e-transport by water. Parcels will no longer be delivered to the front door, but to neighbourhood hubs, where residents can pick them up after work.

We are creating space for parking, loading and unloading vehicles in and around the city, where successive transport vehicles can connect seamlessly and quickly. Car-drivers must be able to switch more easily to the bus, tram, metro, (shared) bicycle or e-moped, or an electric car-sharing car. In order to tempt people and encourage different kinds of travelling behaviour, we will provide better-connected public transport, an improved cycling infrastructure and digital technology. For example,

we will further develop the concept of Mobility as a Service (MaaS), which will allow people to find the fastest and/or cheapest way of travelling. Everyone will be asked to find ways to cut carbon emissions. Together with businesses, we are looking at options for facilitating working from home. Data and insights from the Mobilab and TNO's Urban Strategy Tool will reveal where and when polluting traffic occurs, so that we can take a focused approach to limiting pollution or introducing cleaner transport.

Boosting car-sharing

Car-sharing leads to a reduction in the number of car kilometres per person, a fall in car ownership, and contributes to cutting carbon emissions and improving air quality. Fewer cars are driven and shared cars are more environmentally friendly, on average. Amsterdam has the most car-sharing vehicles in the Netherlands, and nowhere else is this number growing faster. This is something we want to continue and extend. With our car-sharing programme, *Agenda Autodelen*, we are working with the sector to make all car-sharing vehicles emissions-free by 2025 at the latest. This also applies to classic car-share schemes with fixed parking spaces, to which the cars are returned after use.

Adjusting parking policy

Accessibility and parking policy, particularly for offices, play a decisive role in the business climate. Both have a significant effect on the greening of transport, too. Amsterdam only participates in the development of offices if they can be reached easily by public transport. Together with the private sector, we are aiming to develop office buildings without parking spaces.

Boosting public transport

Amsterdam is continuing to grow. In order to be able to absorb this growth with public transport and keep Amsterdam accessible and attractive, the metro currently links the north and south of the city, and tramlines provide the main link between east and west. A number of stops have been combined, and new stops are being made more accessible and safer for vulnerable groups. We will also propose new connections in the Spatial Vision.

Nowhere else is the number of car-sharing vehicles growing as fast as in Amsterdam

As far as trains are concerned, the rush-hour offering must provide an optimal service for key work and educational locations. By making train rosters shorter and making less of a distinction between intercity and sprinter trains, the existing rail infrastructure can be made more reliable and efficient. This will result in a non-timetable-based, shuttle-like service from all directions. We will improve the accessibility of the most important locations considerably by distributing flows from the various directions more effectively over the key nodes (Centraal Station, Station Zuid, Amstel, Bijlmer ArenA and Sloterdijk).

The measures in this pillar are being developed in the *Agenda Autoluw*, the cycling and *Smart Mobility* programmes, the municipal parking policy, and, in the longer term, in the Spatial Vision.

Actions and measures

Facilitate comfortable cycling networks, including widening busy cycle routes

Facilitate convenient bicycle parking, including expansion of bicycle parking places

Facilitate new cycling norms, including boosting cycling-friendly behaviour

Create more green and active journeys, including creation of space for public transport

Create space with fewer car journeys, including introduction of intelligent access to city centre

Create space by having fewer car-parking spaces, including fewer parking permits

Smart organisation of transport in the city, including working on alternatives to ownership

Use technological innovations, including smart bicycle-parking

Smart use of new mobility solutions, including neighbourhood hubs with electric vehicles

Research business and commuter transportation of employees using cycling and public transport

Shared municipal service vehicles using a municipal carpool

Pillar 9
Greening all polluting vehicles and vessels

With the expected growth of Amsterdam and the region, we must do everything we can to limit carbon emissions resulting from increasing mobility. We are broadening and accelerating our approach.
This area is being tackled programmatically in the waterways programme (*Programma Varen*) and the Clean Air Action Plan (2019). In this action plan, we describe an individual approach and time horizon for each target group. It contains specific measures to achieve an emissions-free city by 2030, mainly by switching to emissions-free forms of transport; that is, vessels and vehicles that are powered by electricity or hydrogen in combination with fuel cells. The energy used should ultimately be generated sustainably, and ideally used in an energy-efficient way.

All traffic will be emissions-free by 2025, with the exception of passenger cars and motorbikes within the A10 ring road

In 2025, all traffic – with the exception of passenger cars and motorbikes within the A10 ring road – will be emissions-free. For mopeds and motor-assisted bicycles, this will apply to the whole built-up area. By 2030, all traffic within the built-up area should be emissions-free.

Stricter and enlarged environmental zones

Environmental zones are the main regulatory tool for banning old and polluting vehicles and, in the longer term, making them emissions-free. In the coming years, we will enlarge the current five environmental zones and introduce stricter requirements. This concerns the environmental zones for lorries, buses, delivery vans and taxis; the environmental zone for mopeds already covers the entire municipality. In 2020, we will introduce a new environmental zone for diesel passenger cars.

All vessels and vehicles emissions-free

Our approach ensures that all vehicle categories gradually switch to emissions-free power. We tackle each category individually, but the approach always entails a mix of awareness-raising, stimulation, facilitation and regulation. We are continuing our policy of boosting electric vehicles with subsidies and privileges, and we use environmental zones and permits to steer the city towards emissions-free traffic.

Cars
Of the 3,600 taxis in Amsterdam, more than 1,000 are already emissions-free. This is partly thanks to the partnership with taxi companies in the 'clean taxis' agreement (*Schone taxi's voor Amsterdam*). In the coming years, we will intensify the zero-emissions policy for taxis in the run-up to becoming emissions-free in 2025. Our contribution includes an electric taxi subsidy and the provision of sufficient (rapid-) charging stations.

We are introducing a new environmental zone for passenger cars, and providing

workshops and test-drive events for businesses. With central government, we are investigating the option of introducing differentiated parking charges, whereby emissions-free vehicles would pay less.

Delivery vans and trucks
We are working on an updated green logistics agreement for delivery vans and trucks. We have introduced new subsidies for emissions-free commercial vehicles, we will provide sufficient (rapid-) charging points, and we are investigating the possibility of logistical hubs that would allow transhipment to clean vehicles. With regard to trucks, we are considering the options for and availability of refuelling facilities for sustainably-produced hydrogen. The first hydrogen refuelling facility will open in 2020.

Amsterdam is a co-signatory of the green deal on logistics (*Green Deal Zero Emissie Stadslogistiek 2025*). Along with our partners, we are working to achieve emissions-free logistics for light vans in 2025. In accordance with the National Climate Agreement, standards for traffic are being developed. The standard for passenger traffic forms part of an approach whereby the authorities are working with employers to reduce commuter traffic (*werkgeversaanpak*). This standard is included in the Environment and Planning Act. In cooperation with the Regional Agency for the Environment, the potential of existing and future environmental regulations for transport is being utilised to achieve this objective, using environmental permits and monitoring businesses.

Passenger and recreational shipping
Passenger and recreational shipping are being made more sustainable in the programme on water transport, *Programma Varen*. From 2025, all recreational boats in the city centre will be emissions-free, and passenger shipping will be 100% emissions-free. By 2030 at the latest, all recreational boats will be emissions-free. The key principles and details of the approach are developed in the *Nota Varen deel II* memo, which states that with the introduction of the new permit system in 2022, all newly-licensed passenger vessels must be emissions-free. We are taking the initiative to install charging points for passenger vessels. The municipality will function as the owner of the charging points and tender concessions for installation, operation and management. We are supporting the installation of charging points by shipping companies and marinas. Ferries are responsible for 25% of the GVB's diesel consumption. Following an agreement between the municipality and the GVB, ferries, like buses, will also be made emissions-free by 2025 at the latest.

The first 29 GVB buses will be emissions-free in early 2020, followed by another 13 buses in 2021

The approach to electrification has been developed. In 2022, the first ferries will be 100% electric (conversion of existing ferries and introduction of new vessels). Between 2022 and 2025, the rest of the fleet will be converted or replaced with new emissions-free vessels.

Public bus and coach transport
The municipality has a partnership agreement on public bus transport with the Amsterdam Transport Authority (Vervoersregio Amsterdam) and the GVB. By 2025, all buses within the A10 ring road will be emissions-free. This will not only affect the 200 GVB buses, but also buses operated by other concession-holders that enter Amsterdam, for which charging points may need to be provided. In total, this will concern around 700 buses in the Amsterdam region. The first zero-emission buses are already operating in Amsterdam, run by the Amstelland/Meerlanden Connexxion regional concessions. The first 29 GVB buses will be emissions-free in early 2020, followed by 13 buses in 2021.

The municipality is organising locations and infrastructure for 'Opportunity Charging': rapid charging locations where vehicles can charge while in service. Charging points are being provided for the GVB and regional concessions. The search for and assessment of locations is taking place in partnership with various municipal departments, the VRA, Liander and concession-holders. The rapid-charging

location at Sloterdijk Station was the first be completed in late 2019. For upcoming phases, we are investigating the following locations: Centraal Station, Holendrecht, Lelylaan, Bijlmer ArenA and Noord. In the longer term, we will probably need 40-45 rapid-charging stations in Amsterdam for all public bus and coach transport. Due to the larger distances involved, hydrogen may play a relevant role as fuel for coaches. We will reflect further on the use of hydrogen for this specific target group.

More charging points for electric vehicles

We are facilitating the growth of emissions-free transport by installing charging points in public space. The number of charging points must rise in line with the increase in the number of electric vehicles. To be able to supply these with power in 2025, we will need 14,000-20,000 public charging points. At present, we have 3,300. There are more than 1,600 private charging facilities in private buildings and car parks, and here, too, it will be necessary to scale up. We are installing charging facilities in our own carparks, and we are encouraging other parties to do the same. In 2020, we will produce a vision document on charging that will describe the expansion of the charging network.

In order to ensure that emissions-free is also genuinely carbon neutral, we want all electricity and hydrogen for transport in Amsterdam to be generated sustainably. This is a precondition for the contracts that the municipality will enter into for the development of public charging points (the figures on CO_2 emissions resulting from transport take account of the national energy mix).

The number of public rapid chargers mainly intended for taxis will be increased from 20 at present to around 60 in 2025. In mid-2020, Amsterdam's first hydrogen station will open in Westpoort. Hydrogen can form a suitable clean fuel for trucks, among others. From early 2020, six refuse trucks will be powered by hydrogen.

By 2025, we will need 14,000-

20.000

public charging points

Innovation

Electric vehicles tend to be parked for longer periods of time, and this creates opportunities for flexible management of the charging current. For example, peak demand on the electricity grid can be avoided by charging cars in off-peak periods. In the near future, electric car batteries can even function as buffers or temporary suppliers for the electricity grid, building or neighbourhood, strengthening the use of locally-generated energy. This makes it easy to fit public charging stations into the electricity grid, and makes transport an important part of the energy system and the energy transition. Amsterdam is initiating and participating in diverse innovative projects in this field, including the Flexpower Amsterdam project, which we expect to be able to scale up from 2021 onwards, in area developments and in the existing city.

In the longer term, hydrogen may become a relevant fuel for heavier vehicle categories, such as lorries and coaches. We are therefore investigating the options, and looking into how hydrogen might contribute to the switch to clean transport.

Actions and measures

Introduce environmental zone (diesel) passenger cars

Investigate the tightening of the environmental zone for lorries in 2022

Tighten environmental zone (diesel) delivery trucks

Geographical expansion of environmental zone

Investigate differentiated parking charges, in partnership with central government

Actively approach owners of old diesel vehicles

Make agreements with businesses and institutions on 100% emissions-free taxi transport

Sign agreement with logistics sector

Build 'emissions-free coalition' of parties in the city for coaches

Explore options for coach hubs

Develop sustainability strategy for GVB ferries

New sustainability requirements for passenger craft with new permit system

Replacement of municipal passenger and delivery transport with electric vehicles

Focus on HVO (biodiesel) municipal fleet during the transition period

Draft vision on charging structure for public charging points

Demand-driven and strategic rollout of charging points

The transition to emissions-free transport requires everyone in the city to play their part

Research the scaling-up of hubs and rapid charging infrastructure for logistics

Facilitate scaling-up of public rapid-charging points for taxis and others

Facilitate roll-out of hydrogen fuelling stations

Set up website for emissions-free recreational craft

Research feasibility of emissions-free water transport

Determine charging locations for ferries

Tender concessions for charging points for passenger boats

Tender concessions for public charging locations for recreational vessels

Support marinas with installation of charging infrastructure

2008

First environmental zone for buses

2009

First public charging points

2019

Agreement on green taxis (updated)

Agreement on sustainable vehicles and fuels in the sanitation industry

2019-2025
Intensify policy transition to sustainable mobility (limited car use, logistics, cycling)

2020

Environmental zone for passenger cars

Vision on charging infrastructure

First 29 GVB buses emissions-free

Existing environmental zones – taxi, delivery, bus and freight – made stricter and enlarged

Green logistics agreement

What is at stake and what is our role?

As the local authority, our role can be summarised as encouraging, facilitating and regulating the transition to sustainable forms of transport, in cooperation with our partners and the private sector.

For the most part, the municipality neither owns nor operates the vehicles that we want to change. The switch to emissions-free transport will require all parties in the city – businesses, residents and visitors – to play their part. Every vehicle-owner or driver will be asked to choose a sustainable form of transport.

With a broad package of measures, the municipality can ensure that the movement in the city goes in the right direction. With respect to transport, we have already been doing this for many years. In the coming period, we will accelerate and scale up this approach. We play an important role in supporting sustainable mobility with **stimulating and facilitating measures**.

We are working with the private sector and transport companies to accelerate the transition

Examples include the abolition of subsidies, providing better public transport, and offering demand-driven public charging points. We are also identifying potential locations for installing charging points for particular target groups, and we are extending privileges to parties that choose green vehicles and vessels.

As a **regulating municipality**, we are limiting the number of fossil-fuel-powered vehicles by abolishing parking spaces or reserving them specifically for green vehicles. We are investigating how to adjust the circulation of motorised transport to make it more attractive for pedestrians and cyclists in particular. The creation of environmental zones acts as an incentive for parties to green or exchange their vehicles. We are working to create taxi ranks that are exclusively for clean taxis. When it comes to professional transport by water, the permit conditions are such that a large proportion of the vessels is already electric.

As a **performing municipality**, we are of course greening our own fleet and ensuring that there are enough charging stations in municipal car parks. We are putting out

2022

All municipal passenger cars and small delivery vans 100% emissions-free

2024

All municipal boats emissions-free

2025

Within A10 ring road: emissions-free taxis, buses, delivery vans, goods transport, passenger vessels, recreational craft and GVB ferries

62 rapid-charging stations for taxis, among others

All municipal sweeper trucks emissions-free

2030

Built-up area emissions-free for all forms of transport

Entire municipal fleet emissions-free

tenders to provide sufficient numbers of high-quality, reliable and affordable public charging points.

We are **working with the business community and transport companies** to accelerate the transition. We are making agreements to reinforce partnerships with transport companies and sector organisations, such as the agreement on clean taxis (*Schone Taxi's voor Amsterdam*) and on green logistics (*Schone logistiek*). We are working with charging-infrastructure providers, the grid operator and electric vehicle manufacturers to create the right conditions in Amsterdam.

This will only succeed if...

The transition to less traffic and emissions-free transport will not occur automatically. The mobility measures in this Roadmap are expected to deliver the greatest overall reduction in emissions, namely -76% in 2030 compared to 2017 (see also chapter 2). In order to achieve this, however, much still needs to be done.

The switch to emissions-free transport requires residents, businesses and visitors to play their part. Owners will have to replace their vehicles. The municipality can encourage and facilitate this, and regulate where necessary. We will hold discussions with the city about how to implement plans, and the conditions that are needed to make the transition succeed. In the Clean Air Action Plan, we have developed measures relating to subsidies, the charging infrastructure and individual actions.

Demand for space in the city is increasing rapidly, while the amount of available space is actually decreasing. We need to make choices regarding our limited public space. These choices are captured in the 27 measures in the limited car transport programme (*Agenda Autoluw*); choices that are the result, in part, of the discussions we have held with the city and the region. It is not always possible to prioritise cyclists, pedestrians and public transport in an area, for example.

Demand for space in the city is increasing rapidly, while the amount of available space is actually decreasing

Having a charging infrastructure is crucial for a clean transport fleet. The success of electric transport in Amsterdam can be attributed, in part, to the current network of public charging points, which are installed on demand. In order to facilitate the desired growth of electric transport, this network must be expanded substantially; not only in public space, but also in semi-public space (such as public car parks) and on private property. Growth is dependent on having available space, and must be adjusted to the local capacity of the electricity grid.

State assistance will play a key role in achieving emissions-free transport. We are calling on central government to provide a package of instruments that will allow us to introduce and harmonise environmental zones. We are also calling for assistance with boosting the transition to electric transport, for example with subsidies. Additional state policy is needed to give direction to our shared ambitions on emissions-free vehicles. On a number of fronts, and as part of the G4 group of municipalities, Amsterdam will urge central government to introduce more ambitious policies, and local space and opportunities to achieve our ambitions. The greening of vehicles, for example, is partly dependent on the outcomes of the state evaluation of environmental zones in 2022.

There is a need for guiding government policy when it comes to emissions-free vehicles

What are we going to do?

It goes without saying that the municipal fleet will be made emissions-free by 2030. In the coming decade, we will replace the 1,200 vehicles in the current fleet with electric variants, as set out in the transition plan for the municipal fleet (*Transitieplan Gemeentelijk Wagenpark*, 2019). All municipal motor scooters are already emissions-free. By 2022, all of the municipality's cars and small delivery vans will be 100% emissions-free; in 2024 all boats; and in 2025 all sweeper trucks. With a view to the technological development of specialised vehicles such as tractors, lorries and refuse trucks, these categories will probably become emissions-free at a later stage, but by 2030 at the latest. During the transition to a 100% emissions-free municipal fleet, the municipality will focus on expanding the use of HVO (Hydrotreated Vegetable Oil, a biodiesel) in diesel vehicles. Using HVO as a fuel results in up to 90% fewer carbon emissions than the use of regular diesel.

In March 2019, the Municipality of Amsterdam signed an agreement on sustainable vehicles and fuels in the sanitation industry (*Convenant Duurzame Voertuigen en Brandstoffen in de Reinigingsbranche*). During the national meeting on fuels (*Landelijke Bijeenkomst Brandstofvisie 2.0*), this agreement was signed by governmental authorities, sanitation services and private-sector companies. The signatories committed to the aim of purchasing emissions-free sanitation vehicles from 1 January 2030, or earlier if possible. Amsterdam has already incorporated this aim into the transition plan for the municipal fleet, which will be largely emissions-free from 2025.

Around 80% of our staff already cycle to work, or take public transport. Our carbon footprint includes business traffic (scope 2) and commuter traffic (scope 3). By making more use of time- and location-independent working, we can reduce the number of journeys taken by our staff. We are looking for ways to boost cycling and public transport, and to reduce business car travel and commuting by car. When booking international travel, the train is always presented as the first option if the journey time is less than six hours, or the distance travelled shorter than 500 kilometres. The organisation offsets the carbon footprint of international journeys, and our business air travel uses sustainable kerosene as part of the KLM Corporate BioFuel Programme.

Many departments still have their own passenger cars, which are only available for departmental staff. In order to develop an efficient and sustainable municipal service vehicle fleet, passenger cars (without special features, lights, etc.) will be added to the carpool. The carpool currently has 57 cars. In the coming years, the vehicles that are currently owned by the departments will be added to the pool. Thanks to more efficient vehicle-sharing, the number of cars fell from 334 in 2014 to 264 in 2019. More vehicles will be added to the pool in the coming years, whereupon they will no longer belong to a single department, but will be available for several departments. This will lead to more efficient usage and allow us to purchase fewer cars. All carpool vehicles will be electric by 2022 at the latest.

Chris Grijns

Health coach, district nurse and mindfulness trainer

"My partner and I don't have any children, but there are more people and children who want to live in this world. I'm very concerned, and I often wonder about how I can contribute to a healthy and liveable world."

"Sometimes I worry about the soil and air quality where we live. I've noticed that other people around here are quite stressed about that, too. They don't know for sure whether the air here is harmful. We live in a lovely place in Noord, but there is a factory just up the road. I don't know exactly what it emits and whether it is harmful."

"We have solar panels on our house. It's great, in any case, to be less dependent on gas. Five years ago, we had to replace the boiler. I was very unsure about what to do at that point, because natural gas will eventually be phased out. At that time, even less was known about it. We nevertheless decided to go for a condensing boiler. I'd be interested in getting a heat pump, but I don't know enough about it Should we buy even more solar panels? That might allow us to become climate-neutral."

"As an individual, I think it's important to contribute to a healthy and liveable world. The municipality should tackle the major polluters at the same time, though; otherwise, it won't make a difference."

"We separate our household waste and we have a compost bin. But I do sometimes wonder how much difference this all makes as a citizen. Are the city's major polluters being tackled? What's the situation at the AEB plant? I think that we should all do our bit, but you shouldn't leave everything to the individual."

Electricity

3.3

Electricity

Electricity plays a key role in the transition from fossil fuels to renewable energy. Due to the transition to a natural gas-free city, we will need more electricity to heat our buildings and for induction cooking. Increasing digitisation and growth in the number of electric vehicles is leading to a sharp rise in demand for electricity. We aim to replace fossil fuels with electricity use, because we can generate electricity sustainably. In order to become climate neutral, electricity must be generated sustainably. Amsterdam forms part of a larger electricity system in which every municipality, region and province contributes maximally to sustainable electricity production. We see many opportunities for generating solar energy on roofs in Amsterdam, and the liberalisation of provincial regulations has also created new potential locations in Amsterdam for generating energy using wind turbines.

What is the challenge?

The demand for electricity in Amsterdam will rise until 2050, as a result of the greening of buildings, extra data-use and electric transport. At present, the generation of the electricity used in Amsterdam results in 1,960 kt of carbon emissions each year; 39% of the total carbon emissions. In order to reduce these emissions, we are working to save energy (see pillars 4, 5 and 6 on energy-efficient buildings). This chapter focuses on the maximal generation of sustainable energy in Amsterdam, based on mature technologies such as solar panels and wind turbines. In the chapter on Harbour & Industry, we consider the conversion of biomass into electricity and heat.

In 2017, sustainably-produced energy made up 6% of the energy used in Amsterdam. Around three-quarters of this renewable energy (electricity and heat) is generated by waste incineration; a quarter comes from solar panels and wind turbines. We believe that in future, we will be able to produce a maximum of 30% of the electricity that we need sustainably, on our own territory. There is considerable support for solar and wind power among Amsterdam's citizens. Research carried out by the OIS in 2019 shows that 75% of Amsterdam's citizens support the switch to renewable energy, and that 90% consider solar and wind energy to be sustainable.

Electricity

CO_2 emissions

1,960 kt

Share of total CO_2 emissions

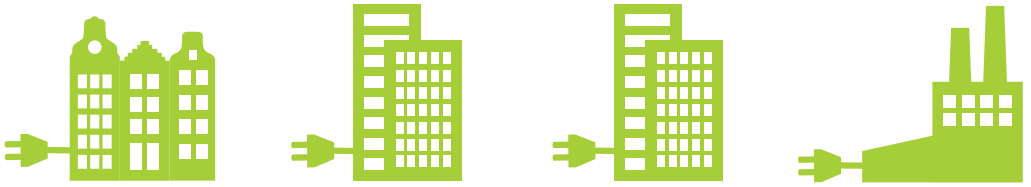
39%

Amsterdam has a lot of roof surface that is suitable for the generation of solar energy, and we believe that every appropriate roof should be utilised. In total, there is space for c. 1,100 MW of solar panels. We are aiming for half of Amsterdam's roof potential to be in use by 2030. By 2040, all suitable roofs should be used for the generation of renewable energy. The ambition for 2022 is 250 MW, based on a growth rate of 50% per year.

Thanks to the liberalisation of provincial policy, our options for installing wind turbines have increased. We want to have 50 MW of extra installed capacity in Amsterdam by 2030, and the necessary permits will be granted between 2021 and 2024. In total, there will be 127 MW of installed capacity by 2030.

Having sufficient capacity in the electricity grid is a precondition for becoming a climate-neutral city. In some parts of the city, the current electricity grid is reaching its limits. The municipality is working with Liander and other stakeholders to future-proof the electricity grid, in line with

Electricity consumption and CO_2 emissions

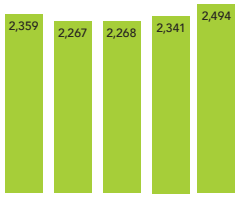


Housing

mln kWh

397 kt (20%)

Business market



mln kWh

1.064 kt (54%)

Social & civic buildings

mln kWh

283 kt (14%)

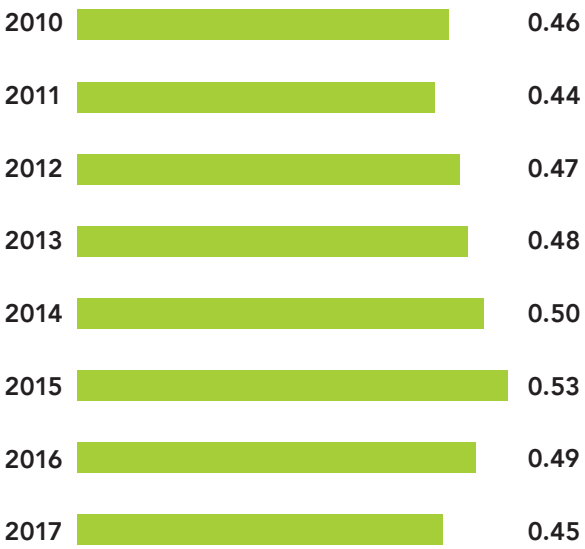
Industry

mln kWh

221 kt (11%)

CO_2 emissions (kg)

(national, per generated kWh)

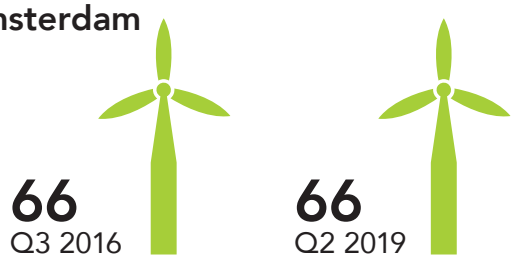


Generation of solar energy in Amsterdam

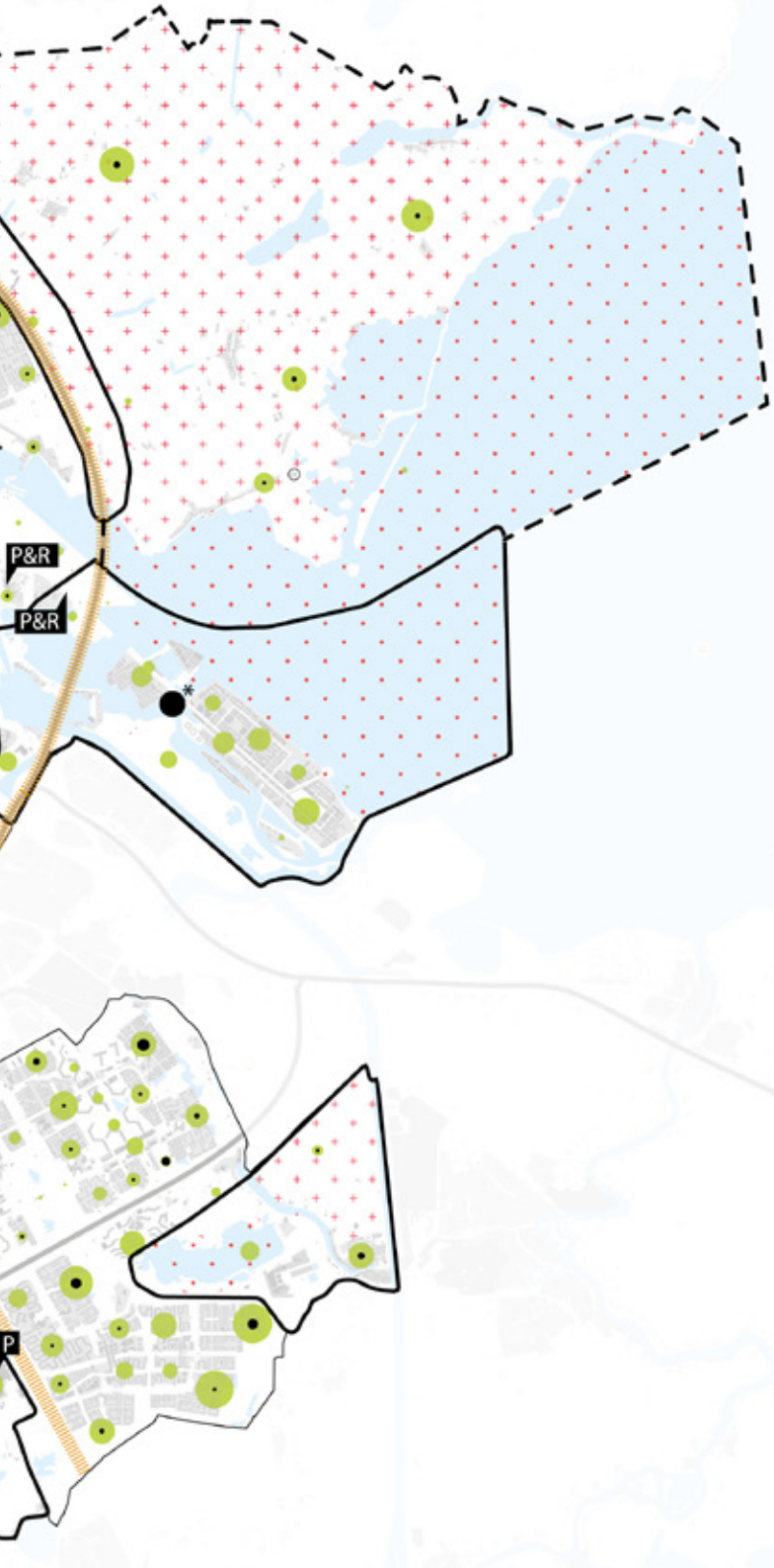
(MW)

Generation of wind energy in Amsterdam

(MW)



Electricity



What does this map show?

For the location of large-scale wind turbines, Amsterdam is considering seven areas where there is technically/theoretically the potential to generate wind energy. Amsterdam has identified the Waterland and IJmeer area as an extra search area. If our ambitions cannot be achieved in the seven search areas or if central government sets additional targets, we will also carry out further research in the extra search area.

When it comes to generating solar energy, the municipality is focusing on large roofs and the dual use of space, for example at P&R sites and alongside infrastructure. Solar farms on greenbelt land and water will be considered if other locations cannot provide sufficient space to meet the objectives, or if central government sets additional targets.

As the municipality has no data available on the generation of solar energy for high-consumption connections in all neighbourhoods (for privacy reasons), these data are not included in the map.

Key

Generation of energy from wind

- Existing wind turbines
- Scaling-up of existing wind turbines
- Search area, new wind turbines
- Reserve search area, new wind turbines

Generation of solar energy

*Actual solar panels on roofs, by neighbourhood (Liander, 2019)**

- 5,000 kW
- 1,000 kW

**Only low-consumption connections (max. 3 x 80 ampere) reference date second quarter 2019.*

* *Combined installed capacity of solar panels for neighbourhoods in Steigereiland Noord and IJburg (Liander, 2019).*

Potential for solar panels on roofs, by neighbourhood

- 10,000 kW
- 5,000 kW
- 1,000 kW

Search areas

- Solar alongside infrastructure – short-term (<2022)
- Solar alongside infrastructure – long-term (>2030)
- P P&R Solar in car parks

Reserve search areas

- Solar on greenbelt (reserve)
- Solar on water (reserve)

the energy transition and other municipal ambitions (see also pillar 20 on space and infrastructure).

We distinguish three main pillars within the Electricity transition path.

Pillar 10
Maximising solar energy generation on roofs

Pillar 11
Optimising use of potential wind energy

Pillar 12
Developing a future-proof electricity infrastructure

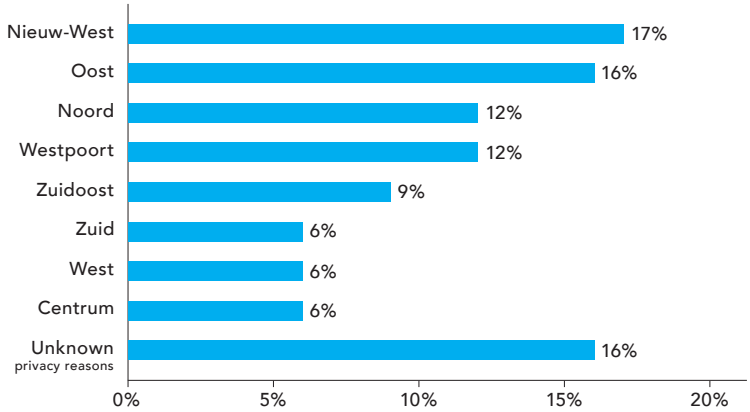
Pillar 10
Maximising solar energy generation on roofs

Pillar 11
Optimising use of potential wind energy

Pillar 12
Developing a future-proof electricity infra-structure

Share of installed capacity solar energy by city district

(4th quarter 2019)



Pillar 10
Maximising solar energy generation on roofs

The installation of solar panels on roofs is not complicated from a technical perspective, and in most cases it is a profitable investment. We have chosen an approach whereby we ensure that there are opportunities for all and the municipality sets a good example. We want to inspire everyone in the city, remove obstacles, and create a climate in which opportunities for large-scale solar power generation are utilised more efficiently.

Various state regulations are crucial for the return on investment period for solar panels, and will thus have a major impact on the increase in the number of solar panels in Amsterdam. It is important that state regulations continue to promote the installation of solar panels on roofs.

Opportunities for everyone

Zonplatform (solar platform)

We are developing a platform that will help Amsterdam's citizens to get started with generating solar energy. People can do this directly by installing panels on their own roof or a hired roof, but they can also join projects organised by solar cooperatives. The *Zonplatform* advises residents, based on their home and preferences, and provides guidelines for immediate action. The *Zonplatform* will form part of the New Amsterdam Climate platform (see also pillar 17 on building the movement in the city).

Conservation areas and monuments

There are options for installing solar panels in conservation areas and on monuments, although not everyone is aware of this. We are using online maps to identify suitable roofs, and will start communicating more actively about this opportunity. We are establishing a help-desk to assist Amsterdam's citizens with applying for permits and drawing up installation plans for solar panels.

Supporting solar initiatives by cooperatives

Citizen ownership and participation will be crucial to the success of the energy transition, and energy cooperatives play a key role here. The Municipality of Amsterdam is working to make more roofs available for cooperative projects. More municipal roofs will be made available, and we are calling on our partners to do the same. Via the *Zonplatform*, we are linking citizens without roofs of their own to cooperative initiatives.

Assistance for private homeowners

It is relatively straightforward for private homeowners (who do not belong to an owner-occupier association) to install solar panels, because they can make their own decisions about what to do when. In the past, we helped homeowners in Nieuw-West with a collective purchase scheme, and we will organise collective purchase schemes across the city to make it more attractive for owners to install solar panels. We will do this in cooperation with neighbourhood frontrunners and local partners, such as the regional energy help-desk (Regionaal Energieloket).

Guidance for owner-occupier associations

It is not straightforward to make buildings with owner-occupier associations (VvEs) more sustainable, due to the decision-making procedures. The Municipality of Amsterdam takes a broad approach to making VvEs more sustainable (see pillar 4 on energy-efficient housing). VvEs are given individual advice and support on solar energy, and have the option of borrowing from the sustainability fund. The municipality's approach focuses on large and small VvEs. Together with partners such as !WOON, we are actively approaching VvEs with solar and energy advice, and we also offer guidance for complex processes. In early 2020, we launched a pilot solar project for small VvEs, *Zon op kleine VvE's*.

There is a lot of space for solar panels on housing corporation roofs

Accelerating the rollout on housing corporation roofs

There is a lot of space for solar panels on housing corporation roofs. Around 40% of Amsterdam's housing stock consists of corporation roofs in full or mixed ownership. We have made agreements on solar projects with housing corporations as part of the performance agreements (2020-2023). The basic principle is that solar panels should always be installed on new-builds and when carrying out renovations, and we will prepare to accelerate the rollout of solar panels on corporation roofs in the coming years.

We are working with housing corporations on specific projects in a project office. We are investigating the options for scaling up solar projects without exposing housing corporations to unacceptable (financial) risks. The basic principle is that citizens with limited funds should also be able to participate, and that tenants should also benefit from solar projects.

Work is underway on projects in complexes that are 100% corporation-owned and in mixed ownership. The knowledge that we gain will be shared actively, so that we can scale up, standardise, reassure and accelerate.

Challenging businesses

Businesses tend to have the largest roofs, where major and rapid steps can be taken. A considerable part of our target can be met on such roofs. A limited number of

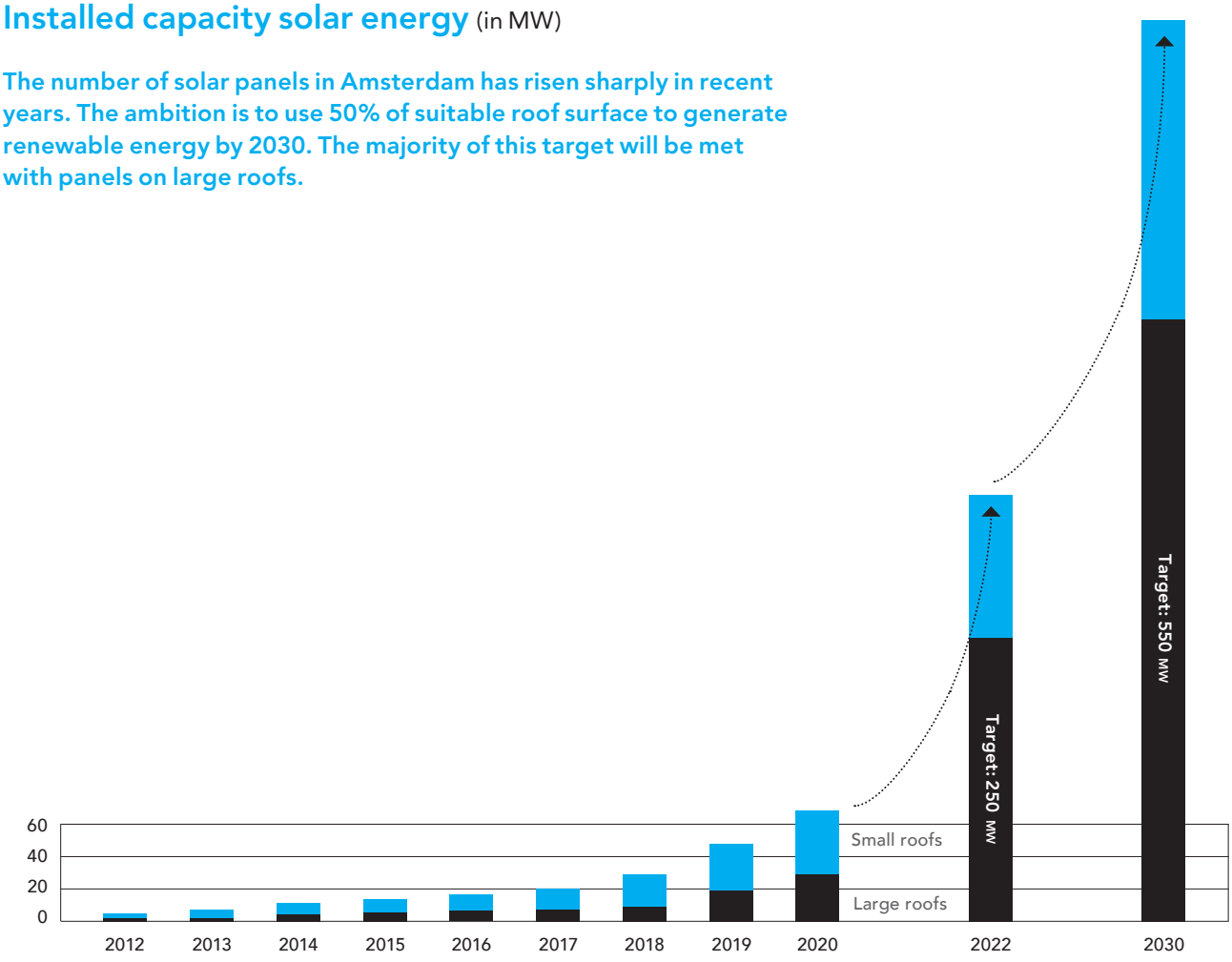
large companies have already installed solar panels. Many companies have applied for state subsidies (SDE+) for solar projects; at present, more than 100 MW of SDE+ solar projects have been initiated, but not yet implemented. We are assisting roof owners with project preparation so that the SDE+ projects can be implemented, and initiating new projects by talking to businesses about their responsibility for contributing to the transition from fossil fuels to renewable energy. We are calling on central government to make sufficient SDE+ resources available for the generation of rooftop solar energy.

At the end of 2019, the municipality and the Port of Amsterdam were in discussions with the largest roof-owners in Amsterdam. Further to the official accommodation discussion (*ambtswoninggesprek*) with large roof-owners, we are drafting a declaration of intent in which businesses, the harbour and the municipality will record their aims regarding the use of rooftop space. Together with the Port of Amsterdam, we are offering expertise and helping to remove potential obstacles. With the grid operator, we looking at how to avoid possible transport limits. In the longer term, more leadership on roof use will also be desirable, in order to bring in late-starters. We are following the minister's plans on the mandatory use of roofs for energy generation with interest.

We are supporting smaller business with a business-park-based approach, in coordination with local business associations.

Installed capacity solar energy (in MW)

The number of solar panels in Amsterdam has risen sharply in recent years. The ambition is to use 50% of suitable roof surface to generate renewable energy by 2030. The majority of this target will be met with panels on large roofs.



Assisting civil society organisations

Solar projects by civil society organisations not only lead to more renewable energy, but also to awareness-raising and support. This effect is reinforced further if residents and members are able to participate in the projects.

When making the switch to solar energy, civil society organisations often need support in the form of expertise and capacity. At the end of 2019, a new project was launched with school boards to install solar panels on school roofs. We are also supporting sports complexes and sports associations with solar projects. In doing so, we are following the state regulations on the greening of sports associations.

Dual use of space and solar farms

An additional 'target group' is our scarce (public) space. Here, too, we see opportunities for solar panels. We are working with the Ministry of Waterways and Public Works to install solar panels on motorway embankments. We are investigating whether solar panels can be installed at P&R sites, possibly in combination with the charging of electric vehicles. We are also working on scenarios for a temporary solar farm on Strandeiland (IJburg).

The generation of solar power in the agricultural landscape and on water will only be allowed under strict conditions. These options will only be considered if other locations do not offer sufficient space, or if central government introduces additional targets. This is also set out in the Regional Energy Strategy (see also textbox on context, page 24).

We are aiming for half of all potential roof surface in Amsterdam to be in use by 2030

Boosting innovation and efficiency

Amsterdam is working for the innovative and efficient use of solar panels in spatial, technological and aesthetic terms. Innovation is needed in order to optimise the use of all potential roof surface, and in the longer term, also facades and glass.

When it comes to industrial buildings, which are not always designed with the additional weight of solar panels in mind, we are considering options for innovative, lighter panels, in partnership with businesses and research institutes. We are following the development of coloured solar panels and solar cells that are integrated into glass and facades. We are investigating whether there is space in Amsterdam for the mobile and temporary generation of solar energy.

Solar energy will play an essential role in the smart energy system of the future. Electric cars can be charged using solar energy, or the energy can be stored in a battery and used when there is considerable demand. We are working with Liander on smart network management based on renewable energy.

Actions and measures

Develop a step-by-step online plan for getting started with solar energy (*Zon Zonder Zorgen*)

Support solar energy projects in conservation areas and on monuments.

Accelerate solar energy on housing corporation roofs and undertake joint projects

Advice and guidance on solar energy for VvEs

Organise collective purchasing of solar panels for Amsterdam's residents

Encourage and talk to businesses about using roofs to generate solar power

Support civil society organisations with installing solar panels

Provide advice on solar energy to businesses and civil society organisations

Support holders of SDE state subsidies when implementing solar projects

Provide loans for solar projects from the sustainability fund

Prepare locations for solar projects alongside infrastructure

Develop opportunities for installing solar panels at parking locations

Communicate about innovative opportunities for generating solar energy

Rollout of solar panels on municipal property

Pillar 11
Optimising use of potential wind energy

For many years, provincial policy prevented us from finding new locations for wind turbines in Amsterdam. The provincial policy was recently liberalised, creating greater potential for wind energy in the city. We aim to make optimal use of space that is suitable for generating electricity from wind.

Replacement of small wind turbines

In the summer of 2019, Amsterdam had 38 wind turbines with an installed capacity of 66 MW. After the summer, sixteen small wind turbines were removed. Ten large wind turbines will be added before 2022, bringing the total to 77 MW.

From a technical perspective, there is space for c. 105 MW of extra installed capacity in Amsterdam; this is equivalent to

35

3-MW wind turbines

Search areas for new wind turbines

Finding space for – and building – wind turbines is made-to-measure work. When mapping out all of the potential locations for wind turbines, we analyse the 'hard' spatial obstacles to turbine installation. Wind turbines have to be built at a certain distance from housing, for example, in accordance with noise and safety regulations. There are also rules on the height of wind turbines in the airspace of Schiphol Airport.

We discussed the outcomes of the analysis of hard obstacles and various scenarios for wind turbines with citizens and stakeholders as part of the Regional Energy Strategy (RES). Based on these analyses and discussions, we produced a map showing seven search areas for wind turbines (see also the map on page 126). The Waterland and IJmeer area has been identified as an extra search area. If we are unable to achieve our ambitions in the seven search areas, further research will also be carried out in the extra search area.

The map showing the search areas is also included in the draft RES for the Amsterdam sub-region, and forms input for Amsterdam's Spatial Vision and Environmental Plan. The search areas for wind turbines in Amsterdam's Spatial Vision and Environmental Plan will replace the search areas in Amsterdam's vision document on wind power (*Windvisie*, 2012).

From a technical perspective, there is space for c. 105 MW of additional installed capacity in Amsterdam; this is equivalent to 35 3-MW wind turbines. This maximum potential does not allow for provincial limits or conservation guidelines. Ultimately, the development of wind turbines will also be dependent on technical and spatial factors, support, the business case and ground positions.

Preparation of new locations

Within the search areas for wind, we will investigate spatial feasibility, construction and operation, and a suitable development strategy. This will be done in partnership with spatial experts and initiators (such as wind cooperatives), in consultation with nearby residents. Conflicts of interest between different spatial claims will be assessed at the administrative level, and decisions will be made regarding final locations and realisation.

It is our ambition to be able to realise 50 MW of extra capacity by 2030, and to grant the permits for the turbines by 1 January 2025 at the latest. We are focusing on wind turbines in the 2-3 MW category or larger; we are thus looking at 17 3-MW wind turbines or more 2-MW wind turbines.

Participation in wind projects

All citizens must be able to benefit from the generation of wind energy, and we are aiming for at least 50% local ownership (residents and businesses) of electricity production. The party taking the initiative will organise a desirable and feasible form of participation. This could take the form of procedural participation, financial participation, financial obligations, ownership participation, a community fund, or a combination of these. The municipality will check that there is a dialogue between the initiators and parties in the surroundings. A project plan will be drawn up for each location, describing how participation will be organised optimally in the project. Agreements with parties in the surrounding area will be recorded in a contract.

Depending on the situation, the municipality may decide to play a role in the development of wind power; if a location is not attractive to private-sector parties, for example, or if more residents are able to participate as a result.

All citizens of Amsterdam must be able to benefit from the generation of wind energy

Actions and measures

Replace 16 0.66-MW wind turbines with 10 2.2-MW wind turbines

Establish the Regional Energy Strategy (RES), including wind search areas

Establish Amsterdam's Spatial Vision and Environmental Plan, including wind search areas

Investigate the spatial-technical feasibility of wind turbines in each search area

Investigate suitable locations, construction possibilities and operating models

Draw up project plans for residential participation with developers

Pillar 12
Developing a future-proof electricity infrastructure

Complex adjustments will need to be made to the electricity infrastructure above and below ground. More space will be needed above ground for substations and transformer houses, so that electricity can be supplied to houses and cars at the right voltage level.

Liander and the Municipality of Amsterdam are working intensively to future-proof the electricity network by means of strategic planning, reinforcement and expansion, and better and smarter utilisation of the electricity grid.

Project in the spotlight

An energy source just outside the door!

Local residents and energy committee-members Aad Verkleij and Siem Goede are working hard to make the Eastern Harbour Area more sustainable. In 2020, a concrete plan will be developed for heating several owner-occupied blocks with aquifer thermal energy.

"In 2019, the residents' association held a conference on what we wanted the Eastern Harbour district to be like in 2025", explains Siem. "At the conference, we set up the energy committee. It now consists of twelve enthusiastic local residents with expertise. In 2020, we will present a plan for sustainable heating and electricity in the Eastern Harbour Area."

Owner-occupier associations are being approached to install solar panels for electricity generation, and small-scale, local, collective solutions are being sought for heating. Aquifer thermal energy storage came up as an option during the research. Siem: "Almost every building here is located on a waterside quay. In our neighbourhood, there's lots of energy just outside the door, so we'll be using it! Water that's been heated by the sun is hot enough. The only thing we need to do is harvest it."

Aad: "A heat pump and electricity can be used to raise the temperature to a sufficient level. The advantage is that you don't need large-scale generation using combustion. This means that aquifer thermal energy storage is cheaper and more sustainable than a large-scale, high-temperature heat distribution grid. That also goes down well in the neighbourhood."

The question is when the Eastern Harbour Area should make the switch. Siem: "The homes are in a mixed state; it's a question of finding the right moment. For example, a number of large owner-occupier associations in the neighbourhood are having acute difficulties with flue gas from aging central heating systems. They need to make large investments right away. The transition could be linked to that, and you could insulate the homes more effectively at the same time."

Aad: "We want to develop this vision in partnership with the municipality. In this way, we'll be able to influence the heat transition and shape the climate agreement, which advocates 50% local ownership. We're launching our initiative with several waterside owner-occupier blocks, to show that it can be done."

Looking ahead and strategic planning

Developing a future-proof electricity infrastructure is an adaptive process that takes place via many channels. It is not a systematic process with clear steps from A to B. New decisions will need to be taken, based on new information and insights.

We will try to look ahead as far as we can, in close collaboration with our partners, so we can anticipate the expected developments in area development, natural gas-free districts, electric transport and sustainable power generation, as far in advance as possible. The municipality has taken the first steps by implementing the study on electricity (*Themastudie Elektriciteit*), identifying new locations for and building new substations, deciding to devise a new location policy for datacentres, and continuing to harmonise the coordination system for construction works.

Our ambitions and search areas for large-scale solar energy and wind power are set out in the Regional Energy Strategy (RES). By drawing up the *Transitievisie Warmte* (TVW), we will clarify which homes/neighbourhoods/districts will be disconnected from natural gas at what time, and using which preferred technology. The network operators Liander and TenneT will be able to include the information from the RES and the TVW in their investment plans

Managing the integration of the electricity infrastructure

To date, utilities assessments and decision-making have often taken place at the project and task level, whereas in order to achieve all of our ambitions, integral assessment is needed at a higher scale-level, from a medium- to long-term perspective. Building a substation requires space and has a lead time of 5-8 years, and space is also needed underground for new electricity cables (see pillar 20).

Building a substation requires space and takes 5-8 years

Smart planning

The streets will need to be dug up in order to carry out the works. The strategic planning of all the construction works is a complex task. On the one hand, because we do not yet know exactly when which homes, neighbourhoods and districts will be disconnected from the natural gas grid, with the aid of which technologies; and on the other hand, because our planning takes account of the modernisation and expansion of the sewer system, the drinking water supply, the gas mains, telecoms cables and renovations to bridges and quays.

We are investigating whether we can improve the strategic planning of works in public space and underground, in partnership with Liander, Waternet, Nuon and telecoms companies, among others. We plan as strategically as possible, so that streets only have to be opened up once for works and renovations, and this is balanced effectively against maintaining accessibility in the city.

The municipal working group on the substratum, *Ondergrond van Amsterdam*, is working on better data collection, data management and more effective data provision on underground assets. Together with the COB (Centrum voor Ondergronds Bouwen), Bouwcampus, fourteen other large municipalities and many private stakeholders, we are investigating whether management of the substratum can be improved.

Actions and measures

Reserve space for new substations, among others

Use electricity grid more efficiently by reducing peak load

Implement the *Themastudie Elektriciteit*

See pillar 20 for other actions and measures

What is at stake and what is our role?

We follow different strategies for solar, wind and infrastructure. Below, we explain the strategy for each pillar.

More solar panels on roofs

When it comes to generating solar energy, the key parties are the owners and users of buildings. They must take the step of installing solar panels on roofs, or make roofs available to Amsterdam's citizens. The motivations of these owners or users can differ, as can the opportunities, investments and yield.

The municipality plays various roles to boost solar energy generation in the city. Our most important role is to support target groups in their ambitions to install solar panels on roofs. We are doing this by informing, stimulating, facilitating and 'reassuring'.

More demand for sustainable electricity is putting pressure on the infrastructure

As a regulating municipality, we play a role in facilitating or even compelling the generation of solar energy on new buildings. This is done with zoning plans (or environmental plans), land allocations and tenders. In the existing city, we help initiators to search for space for solar panels within the prevailing rules and laws; for example, by providing more clarity on solar panels on monuments and in conservation areas. We are researching the options for facilitating municipal management of the use of roofs for sustainably generating solar energy.

As a 'cooperating' municipality, we make agreements with the owners of large roofs. We make our own direct contribution by generating the maximum amount of solar energy on municipally-owned roofs.

2019-2022

- Establish search locations for wind (2020)
- 250 MW solar (2022)
- Extra support for solar projects: 'Year of the Sun' (2020)
- Solar offering for all; *Zon Zonder Zorgen* platform (2020)
- Solar 'green carpet' for conservation areas/ help-desk for solar projects in conservation areas (2020)
- Strategic rollout of solar panels on municipal roofs (2020)
- Make municipal roofs available for cooperative solar projects (2020-2022)
- Launch solar energy on housing corporation roofs with 15-20 projects (2020-2022)
- Develop more steering instruments (environmental law, etc.) (2020-2022)
- In harbour area: remove 16 small wind turbines (each 0.66 MW) and add 10 large wind turbines (each 2.2 MW)

2020-2025

- Develop solar energy on facades and other surfaces: permits for 50 MW extra wind

Ensure that all citizens can benefit from and own wind turbines

When it comes to the generation of wind energy, the key parties are wind cooperatives, energy companies, developers, grid administrators, nearby residents, central government and the Province of Noord-Holland. The municipality's most important role in this area is to regulate. The municipality is tasked with identifying locations for new wind turbines within the search areas (see also the map on page 126). We will chart the maximum potential for each search area. In consultation with spatial experts, nearby residents and other stakeholders, we will prepare decision-making on the installation of wind turbines and encourage citizens to become owners.

When it comes to future-proofing the electricity infrastructure, the key parties are the network operators Liander and TenneT

Anticipating developments towards a future-proof electricity infrastructure

When it comes to future-proofing the electricity infrastructure, the key parties are the network operators Liander and TenneT. The energy transition will require new forms of cooperation, allowing us to anticipate major changes. As a cooperating municipality, we are working with the network operators at a strategic, tactical and operational level to develop a future-proof electricity network.

As a regulating municipality, we can use spatial planning policy to manage demand for and the supply of electricity. We determine where new residential neighbourhoods and generation facilities will be built, and manage the arrival of large energy-consumers such as datacentres. As a municipality, we are concerned with the organisation of public space. We will also take the lead on the construction and adaptation of the grid, limiting disruption as much as possible.

2030

550 MW solar (half of roof potential used)

All municipal roofs have solar panels

Realise 50 MW extra wind (127 MW in total)

2040-2050

No roof in the city left unused (1,100 MW)

2050

This will only succeed if...

Management of roof-use is dependent on state regulation

Although the municipality wants no roof to remain unused, we have a limited ability to achieve this, as we have no say over roof-use in most cases. We are thus dependent on roof-owners, and their business case is dependent on national rules, tax law and subsidies (see also chapter 4 on service provision and instruments).

With the introduction of the Environment and Planning Act, Amsterdam will investigate the options for promoting solar energy on the roofs of new and existing buildings. In addition, we are creating space for solar panels on facades, alongside motorways and on wasteland.

Major pressure on the electricity infrastructure

Increasing demand for and the larger supply of sustainable electricity is putting major pressure on the electricity infrastructure. Despite all of the efforts by Liander and the Municipality of Amsterdam to reinforce the network, make the network smarter and build substations, peak-load can lead to local bottlenecks (congestion) if maximum grid capacity is reached. This has yet to occur in Amsterdam, but it has the potential to happen. It is already a challenge to offer sufficient transport options to large energy-consumers and solar projects on large roofs. Liander and the Municipality of Amsterdam must continue to work together closely to solve and prevent specific problems.

Generating a large amount of sustainable electricity is a major challenge in a compact, densely-built city such as Amsterdam

The battle for space

Generating large quantities of sustainable electricity is a major challenge in a compact, densely-built city such as Amsterdam. The sustainable generation of electricity has a visible impact on the city and the surrounding landscape. In some places, choices will need to be made between building homes, sustainable generation, business parks and nature or the agricultural landscape. Combinations will be possible in many cases, but not always. As a result, there will always be people who are for and against the installation of wind turbines. We are therefore aiming for at least 50% local ownership of wind turbines, and for nearby residents to be able to profit from the energy that is generated. The battle for space also applies to the infrastructure that is needed above and below ground (see further pillar 20).

We have installed solar panels on

20%

of municipal buildings to date, with a total capacity of 3-4 MW

What are we going to do?

In 2019, the municipality concluded an energy contract with Green Choice for supplying power to the municipal organisation. The electricity, which is being supplied from 1 January 2019, is generated 100% sustainably using wind, solar or biomass, and is sourced from the Netherlands. The agreement includes an obligation whereby the total capacity consumed by the municipal organisation will be generated within seven years by new wind turbines, which will be built for this purpose in the coming years. In this way, we are actively contributing to the growth of the available renewable energy sources in the Netherlands.

We have installed solar panels on 20% of municipal buildings to date, with a total capacity of 3-4 MW. The installation of another 2-3 MW of solar panels on municipal roofs is underway and will be completed in 2020. The total solar energy potential of our roofs is 15 MW; this is equivalent to around 50,000 panels and enough electricity for around 5,000 households per year. In the first quarter of 2020, we will draw up a plan for installing solar panels on the next tranche of municipal roofs. We are working with Amsterdam-based energy cooperatives on the installation, and looking at how we can help citizens to benefit from solar panels on municipal property. By 2030, solar panels will be installed on all suitable municipal buildings.


BIJENBAAS

Adriaan van der Tang

Beekeeper at Bijenbaas

"As a child, I loved playing outside in nature. It would be great if my little nephew (3) and niece (5) could do the same. I am sometimes scared when I read about how many animal species are becoming extinct each day, the shortage of raw materials, the melting polar icecaps and the burning rainforests. In order to stop this, we have to do something now."

"I try to be as sustainable as I can be in my daily life. I use public transport as much as possible, for example, and avoid flying if I can. If I buy something, I take note of where it comes from, or whether it's a certified product. I almost always buy second-hand now. I live in an old rental home that's typical of the city. You can't cook with induction here, because the fuse box can't take it. I'm still using gas for the time being. We do have insulating foil behind the radiators, and windows with double glazing. We also made a deliberate decision to go for a renewable energy supplier."

"Ideally, I'd like to make everyone in Amsterdam and the surroundings aware of the need to protect bees, and ultimately to promote biodiversity."

"I live in the centre of Amsterdam, and sometimes I'd love to prise up a few paving slabs and chuck some flower seeds underneath – in just one year, this would already have an impact on biodiversity."

"I recently became a beekeeper at Bijenbaas. Bijenbaas installs beehives on roofs in the city, such as the roofs of offices, to promote biodiversity. If I can ensure that a hundred beehives are installed in one year's time, then I'll have made a real contribution to biodiversity in the Netherlands."

Harbour & Industry

3.4

Harbour & Industry

Amsterdam's harbour forms part of the North Sea Canal Area. The area has two main roles: the logistical role played by the seaports and as a space for industrial activity. Amsterdam's harbour employs more than 32,000 people, directly and indirectly. The activities in the harbour vary from industrial production to goods and fuel storage and transhipment, urban freight distribution, waste processing and energy generation. Energy plays a key role in this: for industry, in terms of the consumption and generation of energy, and for the harbour, in terms of its crucial position in the global energy trade. For the Harbour and Industry path, the opportunity and the challenge is to go from being a fossil energy cluster to being a frontrunner in sustainable energy, heat and alternative fuels for shipping and aviation.

What is the challenge?

Each year, industrial companies in Amsterdam emit 920 kt of CO_2 (18% of the total), more than half of which comes from AEB Amsterdam. Most of the industrial companies are located in Amsterdam's harbour area. If we are to meet our climate targets, the harbour economy must become more sustainable. The harbour area as a 'sustainable battery for the city, region and Europe' is a vision of the future harbour economy with few or zero carbon emissions and lots of space for generating, storing and distributing renewable energy to end-users on an industrial scale. The new harbour economy will deliver renewable energy products and services, including sustainably-generated electricity, green hydrogen, sustainable fuels, energy storage capacity and switching capacity. Carbon Capture, Storage and Utilisation (CCSU) will play a role in the new harbour economy. The harbour will thereby form a key link in the energy transition for industry, electricity production, international aviation, mobility and the built environment.

In the Harbour & Industry transition path, Amsterdam's carbon emissions include the emissions of all companies that are categorised as industrial companies by Statistics Netherlands and located in Amsterdam, including AEB's waste incineration plants and Waternet's sewage works. The following fall beyond the scope of the Roadmap:

- Industrial companies that are located outside the municipal borders;
- Aviation and shipping;
- The Hemweg gas plant.

Harbour & Industry

CO_2 emissions

920 kt

Share of total CO_2 emissions

18%

In the Harbour & Industry transition path, the approach is based on the following pillars:

Pillar 13
Transforming the harbour into a sustainable battery

Pillar 14
Developing the green hydrogen economy

Pillar 15
Carbon capture, storage and utilisation

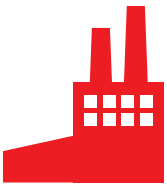
Pillar 16
Saving energy in industry

Consumption and CO_2 emissions

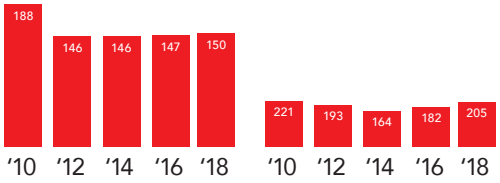
Waste incineration

N/A no energy consumption

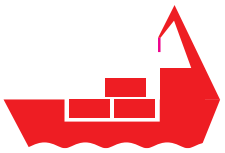
553 kt (60%)



Natural gas and heat consumption, industry



262 kt (29%)



Fuel consumption inland shipping and fishing

No data on energy consumption available

24 kt (3%)

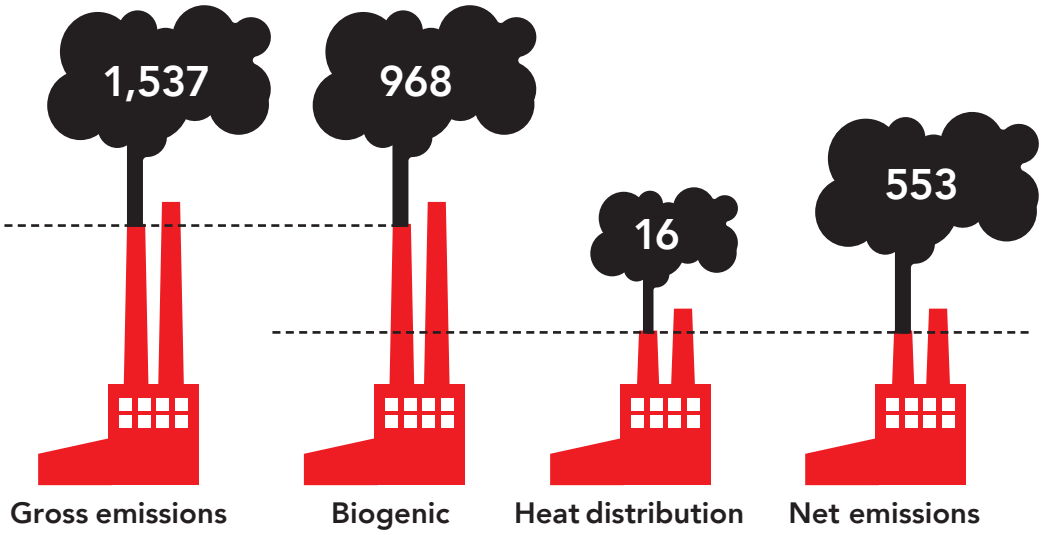
Other greenhouse gasses, industry

N/A no energy consumption

76 kt (8%)

CO_2 emissions, waste incineration at AEB

(kt 2017)



Notes

AEB's total carbon emissions were 1,537 kt. Sixty-three per cent of the emissions were caused by the incineration of biogenic waste; in accordance with IPCC guidelines, these emissions do not count towards Amsterdam's emissions. Of the remaining emissions, 16 kt were caused by the consumption of heat in Amsterdam that was generated by AEB. These emissions count as part of the Built Environment transition path. The other 553 kt of emissions count as part of the Harbour & Industry transition path.

Pillar 13
Transforming the harbour into a sustainable battery

'The harbour as a sustainable battery for the city, region and Europe' is the shared future vision of the harbour, as a place where renewable energy will be generated, produced, converted, stored and distributed to end-users on an industrial scale. We support this vision, and will ensure that the Port of Amsterdam and the companies in the harbour are able to undertake this transition successfully. As a 'sustainable battery', the harbour will contribute to reducing carbon emissions in industry and the energy transition in other sectors. The 'sustainable battery for the city, region and Europe' is a clear vision for businesses located in the harbour, and offers plenty of space for innovation and investment.

The key principle is to maximise the use of existing knowledge and expertise, networks and infrastructure for an effective transition to fewer CO_2 emissions and more renewable energy sources. Wherever they can, existing harbour companies that are still oriented towards fossil fuels should form part of the transition as far as possible. At the same time, in the coming decades we will actively encourage reductions and aim to phase out fossil activities.

From fossil cargo flows to sustainable fuels

At present, Amsterdam's harbour economy is largely based on the storage and transhipment of cargo flows of fossil fuels, such as coal and oil products. In 2019, a total of 50 million tons (c. 50% of the total transhipment) of oil products and 15.5 million tons (c. 20% of the total transhipment) of coal was shipped. At present, Amsterdam's harbour forms part of the fossil fuel chain that contributes to global warming. This revenue model will be made more sustainable, as it is untenable in the longer term.

A 'sustainable battery for the city, region and Europe' is the shared future vision of the harbour

In 2013, the Port of Amsterdam announced the ambition that no coal for electricity production would be stored or transhipped in the harbour from 2030. The Port of Amsterdam ceased to grant new sites to oil terminals in 2008. It also helps its clients to develop sustainable alternatives for the space that becomes available.

In line with the Paris Agreement, the objective is to make the city and the harbour climate-neutral. Although the storage and transhipment of fossil fuels does not lead directly to emissions in Amsterdam, it does contribute to emissions elsewhere. It is therefore necessary to transform the existing energy cluster in the harbour into a sustainable energy and fuels cluster that includes green hydrogen, biofuels and synthetic fuels. This means that we aim to phase out fossil fuels and switch to renewable energy and fuels by 2050. The Port of Amsterdam described this as its key principle when drafting the strategic plan for 2021-2025. The aim is to combine ambitious and realistic efforts to tackle the climate challenge with a strong, future-proof harbour economy, a good, reliable relationship with companies in the harbour area, and to guarantee the continuity and profitability of the Port of Amsterdam in the longer term. The rate at which this will be achieved in the run-up to 2050 will depend on European and national climate policy and (international) market developments, among other things.

The municipality is working to create new value and raw material chains for the harbour and industry, including for aviation and shipping. We are providing active support to facilitate the phase-in of the storage and transhipment of sustainable fuels, including biofuels, synthetic kerosene and hydrogen. The municipality is contributing to this ambition with investments in infrastructure, expertise, pilots, and with the development of a local mar-

ket, by acting as a 'launching customer'. Together with the Port of Amsterdam, ORAM and the companies based in the harbour, we are also lobbying central government and Europe. In this way, we are creating new business cases for these new value chains.

Climate justice

When it comes to climate justice, the energy transition in the harbour as a 'battery for the city' will also create new employment opportunities. Jobs will disappear, too, and it is essential that employees are given training opportunities and work experience in good time. Employers are primarily responsible for ensuring that their employees receive proper guidance during the transition and are trained in a timely way, and the municipality can provide support with this. The municipality is also keen to start collaborating with companies that are searching for more employees as a result of the energy transition, and want to tackle this together.

Actions and measures

Explore financial instruments for the transition to becoming a sustainable battery

Draw up a lobbying strategy

Develop an ambitious target for the generation and storage of renewable energy

Hold four expert sessions with key players in the harbour area

Chart the implications of the climate ambitions for employment in the harbour area

In the North Sea Canal Area, too, hydrogen is seen as an important link in the future regional energy system

Pillar 14
Developing the green hydrogen economy

The Port of Amsterdam and various businesses in the harbour see great potential in the development of (green) hydrogen as a sustainable fuel. Central government has also expressed its strong commitment to the development of hydrogen in the National Climate Agreement and the national hydrogen programme (*Nationale Programma Waterstof*). In terms of expertise, the Netherlands is well-placed to develop electrolysis technology. Hydrogen is also seen as an important link in the future regional energy system in the North Sea Canal Area. A study on the energy infrastructure in Noord-Holland (*Systeemstudie energie-infrastructuur Noord-Holland*, CE-delft, 2019) assumes that green hydrogen will provide between 6% and 31% of the entire energy supply of the North Sea Canal Area region by 2050, including for heavy goods transport and industrial processes, and as an energy buffer.

Hydrogen as a supplement to the electricity system

Green hydrogen is no replacement for sustainably-generated electricity; from an energy perspective, it is always better to use sustainably-generated electricity as directly as possible. However, green hydrogen can serve as a replacement for natural gas in industrial processes that require high temperatures. In addition, in the longer term, hydrogen can play an important role in temporary storage and as an energy buffer in the future electricity infrastructure.

One of the characteristics of sustainable electricity generation based on solar or wind power is its irregular character; the

What is hydrogen?

Hydrogen (H) is the most common element in the universe and the lightest atom in the periodic table. Hydrogen gas (H2) can be used as a fuel. In order to produce hydrogen gas, an energy source is needed.

Hydrogen gas can be made in various ways:

- Electrolysis: electricity is used to split water molecules (H_2O) into hydrogen gas (H_2) and oxygen (O).
- The 'separation' of natural gas (steam methane reforming). Methane (CH_4) is converted into CO_2 and hydrogen gas (H_2). The same principle can be applied to biogases.

We can distinguish between grey, blue and green hydrogen:

- Grey hydrogen is made from natural gas. After the hydrogen molecules and CO_2 have been separated, the CO_2 is released into the atmosphere as a waste product.
- Blue hydrogen is also made from natural gas, but the CO_2 that is released in the process is captured and reused, or stored.
- Green hydrogen is made by electrolysis, based on sustainable electricity. It is also possible to produce green hydrogen based on sustainable biomass.

As no harmful gases are released when using green hydrogen as a fuel or raw material, it is fossil-free and (almost) climate-neutral. When converting sustainable electricity into hydrogen and using hydrogen in fuel cells or converting it back into electricity, there is performance loss of around 50%. Hydrogen gas is highly flammable and also has a low energy density. This means that specific fuel storage facilities are needed to store and transport hydrogen.

Current developments in the region in relation to green hydrogen

- Vattenfall aims to redevelop the Hemweg site as a renewable energy facility producing sustainable electricity, hydrogen, heat and synthetic kerosene for shipping and aviation. The coal-fired power station was shut down on 23 December 2019; the gas plant is still in operation. See also the 'Project in the spotlight' for Harbour and Industry.
- The Port of Amsterdam is working with Nouryon and Tata Steel on the H2ermes project: a 100-MW hydrogen electrolysis plant that will produce a maximum of 15 kt of hydrogen per year, plus oxygen, at the Tata Steel site in IJmuiden. The final investment decision is expected in 2021. By using renewable electricity, this first plant will facilitate carbon savings of c. 350 kt per year (although this will not count towards Amsterdam's CO_2 target).
- Various filling points and fuel station initiatives by Holthausen Energy Points, Shell, Orangegas and Titan LNG, among others. In early 2020, the Holthausen Group, in partnership with the Port of Amsterdam and the Municipality of Amsterdam, will build a fuel station on Australiëhavenweg, which will dispense 200 kilograms of green hydrogen on a daily basis. The Municipality of Amsterdam is working to green its municipal fleet, and many vehicles will be powered by electricity. The municipality is also leasing two collection vehicles and four refuse lorries that will be powered by hydrogen.
- In addition to electricity, heat and biogas, from 2020 Bio Energy Netherlands (BEN) will also produce green hydrogen based on sustainably-sourced biomass. The aim of the plant is to produce 30-60 litres of hydrogen per day, making exclusive use of regional, non-recyclable waste wood. The waste wood will be gasified into 'syngas' that can then be used to generate electricity and heat, or hydrogen (H_2) and carbon dioxide (CO_2).

existing electricity grid is not equipped for this. The electricity infrastructure in and around Amsterdam is nearing its limits, whilst the climate challenge will require much more sustainable energy to be available. In contrast to electricity, hydrogen can be stored for a long time and transported over large distances, for example via the existing natural gas network. Hydrogen can be produced at the times when there is a surplus of green power and can be used at the times when demand is greatest. Hydrogen can thereby contribute to security of the supply and the reliability of the entire energy system. Hydrogen is also seen as an essential component of the production of sustainable fuels for shipping and aviation.

The development of hydrogen chains requires shared commitment

At present, green hydrogen is still in its early days. The rapid development of regional hydrogen clusters is inhibited by the demand and supply paradox. The first promising hydrogen projects will get off the ground in the coming years. For hydrogen to play a significant role in the regional energy system from 2030, however, it will be necessary to build and scale up the chain of production, distribution and acquisition in the years ahead. As with any technology, the costs in the early phases of the development will be high, but they will fall as the technology is used on a larger scale. This will require shared commitment from government and the private sector. Governmental authorities will provide the right preconditions, financial incentives and infrastructures; private sector parties will invest in the development of the technology that will allow green hydrogen to compete other energy sources.

For the development of the hydrogen chain in the North Sea Canal Area, two key industrial infrastructures are needed to link potential producers and consumers of green hydrogen. First, we need a hydrogen pipeline between IJmuiden and Amsterdam that gives companies in the North Sea Canal Area direct access to hydrogen.

Using tankers or the existing gas infrastructure, liquid hydrogen can be transported from the sunniest regions

Amsterdam's harbour area is home to five companies that must stop using natural gas from Groningen, according to central government. Hydrogen can offer a sustainable alternative, both as a fuel and as a raw material. In addition, a link is needed with a national hydrogen network. The existing gas network operated by Gasunie can be used for this, and Gasunie expects to be able to convert the first parts of the gas network to hydrogen in 2025. Using a so-called backbone link, the North Sea Canal Area can be linked via the northernmost tip of Noord-Holland with the industrial cluster in the north of the Netherlands.

In addition, an international market for green hydrogen is expected to develop. Using tankers or the existing gas infrastructure, liquid hydrogen can be transported from the sunniest regions. The costs of generating sustainable electricity are low there, and an almost infinite supply of solar energy is available. As a global energy harbour with a large regional hydrogen market, Amsterdam's harbour can play an important role in the development of the global distribution of green hydrogen.

Hydrogen as a pillar of the Implementation Programme for the energy transition in the North Sea Canal Area

We are working with the Port of Amsterdam and our partners in the North Sea Canal Area to boost the hydrogen economy. The key is to develop the infrastructure on time, to allow parties to start consuming hydrogen directly or feeding it into the energy system. It will also be necessary to work with public and private partners to stimulate innovation and scale up the production and consumption of green hydrogen.

Actions and measures

Develop two essential hydrogen infrastructures

Municipality of Amsterdam as a 'launching customer'

Map out restrictive regulations in relation to the hydrogen cluster, in partnership with the Regional Agency for the Environment

Research track focused on developing a 1-GW green hydrogen plant in the North Sea Canal Area

External consultant/researchers to make inventory of potential demand for green hydrogen

Pillar 15
Carbon capture, storage and utilisation

CCS stands for 'carbon capture and storage'; CCSU stands for 'carbon capture, storage and utilisation'. In a perfectly circular and fossil-free world, there would be no need for CCS. Fossil CO_2 would remain in the ground or circulate in materials that are perpetually reused in new products. We are not there yet, however, and the Municipality of Amsterdam considers it necessary to use CCS as a temporary measure to cut carbon emissions in the short term. We believe that this is only desirable for production processes for which there are currently no alternative fossil-free production methods. The use of CCS should not slow down the transition to a circular and fossil-free economy.

More and more parties are convinced that CCS will be necessary and feasible for reducing carbon emissions in the short term

CCS is needed to meet our reduction targets

CCS is not uncontroversial; various parties have voiced concerns about costs, safety and possible harm to the natural environment. A growing number of parties (national and international) is convinced, however, that CCS is a necessary and feasible way to reduce carbon emissions in the short term. Almost all of the scenarios that have been analysed by the International Panel for Climate Change (IPCC) include the large-scale use of CCS. The IPCC has itself stated that without CCS, the global warming target in the Paris Agreement cannot be achieved. The Dutch government and the Municipality of Amsterdam also hold that CCS – and in the longer term, possibly also CCSU – will probably be needed to meet our target of reducing carbon emissions by 55% before 2030.

To use CCS on a large scale, it will be necessary to capture CO_2, transport it to empty gas fields, and inject it into the empty gas fields deep under the bottom of the North Sea. Carbon capture is most efficient in places where a high concentration of CO_2 flue gases is released into the atmosphere, so-called 'point sources'. Carbon capture plants filter the CO_2 out of these flue gases.

Carbon capture at AEB

In 2017, AEB emitted 1,540 kt of CO2. Of these carbon emissions, 37% were from waste with a fossil source, such as plastics, and other 63% were from waste with a biogenic source. From 2021, the waste incineration sector will pay the carbon tax on the fossil-based component of the emissions.

In 2019, AEB carried out a feasibility study on the capture of 500 kt of CO_2 at the high-efficiency plant. The Municipality of Amsterdam endorses the importance of AEB's ambitions. As soon as there is more clarity regarding AEB's future as an organisation, we will explore whether and when these can be achieved. The municipality aims for as much carbon as possible to be captured.

CCU as a development path towards green aviation

In addition to CCS, it is possible to re-use the CO_2 after it has been captured (CCSU). How far this benefits the climate depends on whether the CO_2 is subsequently released into the atmosphere, and whether other fossil energy sources can be saved as a result. When it comes to aviation, for which there are currently no sustainable alternatives, it is possible to fuel aircraft with synthetic kerosene made from green hydrogen and captured CO_2 from biogenic sources. In this way, aviation can be made climate-neutral in future. There will be an opportunity to develop this and other large-scale applications of CCSU in the coming years.

Biomass

Biomass plays an important role in state policy to meet the carbon emissions target in the Paris Agreement. Biomass has various uses in the energy transition in the Netherlands, including in combustion, gasification and fermentation to make biofuels, heat and electricity. Government policy assumes that biomass will be necessary, on the grounds that there will not be enough affordable sustainable sources available in ten or twenty years' time to take over the role of fossil fuels. Amsterdam also uses biomass for heat and electricity production, including at the Bio-Energie Centrale (BEC) and Bio Energy Netherlands, which plans to start operating in 2020. As of 2021, the biomass heating plant in Diemen will start supplying heat to the eastern heat distribution grid in Amsterdam. Under social pressure, central government is currently reconsidering the role of biomass in the energy transition.

In addition to carbon storage, it is possible to re-use captured CO_2

The role of biomass in Amsterdam

Amsterdam takes a cautious position on the use of biomass: we are essentially opposed to using biomass, unless strictly necessary. Unfortunately, local authorities have limited options to steer policy on this in practice.

First, we emphasise that biomass should only be used if there are genuinely no affordable sustainable alternatives, such as for high-temperature industrial heating. We expect new renewable sources to become available in ten to fifteen years' time, including geothermal heating, aquifer thermal energy and waste heat from datacentres. There is uncertainty about when this will happen, however, and to what degree. In the case that insufficient new sustainable heat sources develop and demand for heat grows more strongly, a situation may arise in which biomass plays a role. Thus, despite our caution, we cannot rule out the use of biomass as an alternative to natural gas in our heat supply.

If biomass proves to be necessary, its use will only be allowed under strict and verifiable conditions. These conditions concern:

- Sustainability (biomass that cannot presently be used for other high-value products, i.e., residual biomass);
- Origin (produced as locally as possible, known origin, no harmful impact on the natural environment, climate-neutral transportation);
- Can be used without negative effects on local air quality (particulates, nitrogen) or creating enormous additional demand for transport;
- Temporary (used for the coming fifteen years at most, until we have more sustainable options);
- In view of the sustainable alternatives for generating electricity, the use of biomass to produce electricity is less desirable than using it for heat production.

Amsterdam is in talks with central government on the government's approach to this issue and the role that municipalities will play. If new biomass market initiatives for arise, the municipality will determine on a case-by-case whether these are desirable and whether it can or should play a role.

Actions and measures

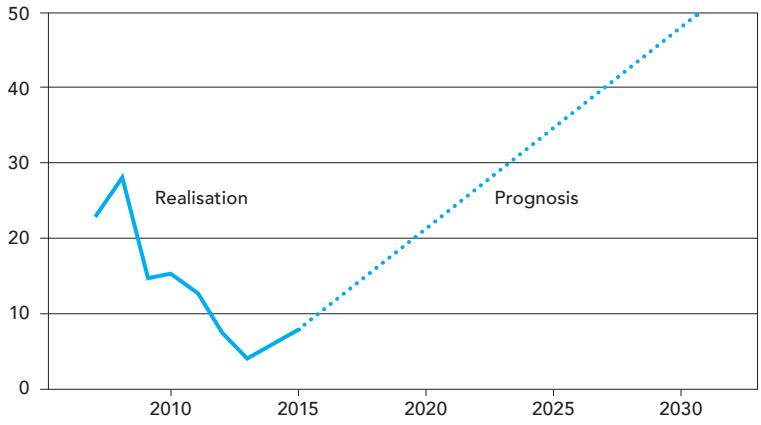
Support the AEB's ambitions

Plan for the development in the harbour of sustainable fuels for shipping and aviation

Develop a regional carbon infrastructure (ATHOS), in cooperation with partners

Realisation and prognosis CO_2 price ETS

(€ /ton, *source: Statistics Netherlands/PBL*)



The National Climate Agreement

The National Climate Agreement contains agreements with the industrial sector on reducing carbon emissions from industry by 59% in 2030, compared to 1990. These reduction targets are anchored in the Climate Law. The national carbon tax is one of the instruments designed to ensure that these objectives are met, and that they apply to all businesses that fall under the ETS, and also to waste incineration plants, such as AEB. The tax will be introduced in 2021. To finance investment in more efficient production methods and renewable energy, companies can apply for the Sustainable Energy Subsidy (SDE++).

Emissions Trading System (ETS)

ETS stands for 'Emissions Trading System'. EU-based companies must have emissions allowances for the harmful greenhouse gases that they emit, and countries and businesses can trade in these emission allowances. As soon as the number of allowances is limited, it becomes costly for businesses to emit emissions, which should lead to more sustainable production processes and investment in more efficient production methods or renewable energy. There are also developments underway at the European level, such as a European Green Deal, adjustments to the ETS (which should also cover aviation and marine shipping) and a new European climate law. These developments will have a direct impact on industry in Amsterdam's harbour.

Pillar 16
Saving energy in industry

Amsterdam has a relatively small industrial sector. Fourteen industrial companies in Amsterdam have annual carbon emissions of more than 1 kt; together, the companies emit 275 kt of CO_2 each year.

The municipality wants to work with these businesses to achieve a zero-emissions industrial sector. This involves the greening of production processes, the heat and power supply, the electrification of processes and the building and expansion of the necessary infrastructure. As a local authority, the Municipality of Amsterdam has a limited set of instruments to coordinate the reduction of energy consumption and CO_2 emissions from industry, and we are therefore advocating the tightening of national and international carbon emissions pricing. Large industrial companies that are based in Amsterdam, such as Albemarle, Cargill and Sonneborn, fall under the international ETS regime. These companies pay for their carbon emissions with emissions allowances. The Netherlands Emissions Authority is officially responsible for registering and monitoring the emissions trade.

In terms of energy consumption, a further category of industrial companies – that do not fall under the ETS, but that do have considerable CO_2 emissions – fall under the authority of the Province of Noord-Holland. These include waste-processing companies, water purification plants and a number of chemical-industrial companies, such as ICL. A number of smaller industrial companies with limited energy consumption fall under the authority of the municipality. Regarding this category, Amsterdam is working with the Regional Agency for the Environment to make maximum use of the legal instruments in the Environmental Management Act, in order to make energy savings and cut carbon emissions. On the application of the Environmental Management Act, see pillar 5 in the chapter on the Built Environment.

Amsterdam takes a cautious position on the use of biomass; it will not be allowed unless strictly necessary

Actions and measures

Hold discussions with the city's ten largest industrial emitters to save energy and cut carbon emissions

The Port of Amsterdam to chart its clients' energy consumption for the Strategic Plan for the Harbour, 2021-2025

The Port of Amsterdam to use its location policy to manage the agreed sustainability objectives

What is at stake and what is our role?

Between 2020 and 2050, the current harbour economy, which is based on fossil fuels and raw materials, must be transformed into a new green harbour economy. The Municipality of Amsterdam has limited instruments to exercise direct influence in the Harbour & Industry transition path. National and international regulations, such as the ETS, the National Climate Agreement and the Climate Law include frameworks and incentives to induce companies to emit less CO2. The national carbon tax on industry and various subsidies – including the subsidy for sustainable energy (SDE++) – are intended to encourage companies to invest in clean energy and greener production processes. The companies themselves invest in more sustainable production processes and in knowledge and technological innovation to scale up renewable energy.

Within Amsterdam's harbour, the Port of Amsterdam is in a strong position to direct the energy transition and to design it in partnership with the private sector. The Port of Amsterdam is responsible for the management, exploitation and development of the land in the harbour area and harbour waters, and is in daily contact with the businesses that are (or want to be) established there. The Port of Amsterdam has a good overview of the developments and opportunities in international energy markets.

With a new form of green industrial politics, the Municipality of Amsterdam is closely involved in the transition and creating the conditions that are needed to enable frontrunners to act decisively. The municipality can contribute financially to the development of the necessary infrastructure for electricity, CO_2 and hydrogen, and ensure optimal legal planning conditions.

Between 2020 and 2050, the current fossil economy must be transformed into a new green harbour economy

The municipality can also promote the desired developments by contributing to fundamental research, pilot projects and demo-factories that focus on innovation and scaling up renewable energy. The municipality can also get markets moving by acting as a 'launching customer'. The municipality is the competent authority for a small number of companies' energy consumption. We have tasked the Regional Agency for the Environment with making agreements with these companies on saving energy, based on the Environmental Management Act (see also the section on the Business Market). We use our power to lobby central government and the EU to facilitate new projects that will accelerate the energy transition in the harbour, industry, the city and the region.

As a shareholder in the Port of Amsterdam, we work closely with the Port to tackle the energy transition dynamically, and at the same time we enable the Port to do this decisively. The partnership with the Port of Amsterdam is set out in more detail in the municipal vision on the harbour.

2020-2025

Hydrogen

2020
First Hydrogen filling station

2020
Introduction of hydrogen-powered municipal refuse and collection trucks

2020
Small-scale hydrogen production based on wood gasification by Bio Energy Netherlands

2020-2022
Feasibility studies on regional hydrogen infrastructure and national hydrogen backbone

2024
Realisation of 100-MW electrolysis plant H2ermes, Tata Steel

CCSU

2020-2022
Preparation of carbon capture plant at AEB

2020-2022
Preparation for ATHOS project (carbon infrastructure for empty gas fields in North Sea)

Steam network

2020-2022
Preparation and planning, steam infrastructure (AEB and Port of Amsterdam)

Phase-out fossil

No more land allocated for new terminals for storage and transhipment of fossil cargo flows

2019
Closure of coal-fired power station on Hemweg

2020-2030
Aim for phase-out of coal transhipment

2025-2030

Hydrogen

Realisation of hydrogen infrastructure (regional and national backbone)

Industry electrifies or switches to hydrogen

Greening of Vattenfall gas plant by mixing in green hydrogen

Scale up hydrogen production to 1 GW, based on offshore wind

We are also inviting the businesses in the harbour to work actively with us. The Port of Amsterdam is currently working on the strategic plan for the harbour 2021-2025, and this will be put to the municipality for approval in 2020.

The options for selling the AEB plant are currently being explored. The municipality and AEB are continuing to search for possibilities to facilitate carbon capture in a responsible way, including if the municipality decides to sell AEB. The municipality can play a role in this, by joining other parties in investing in the necessary infrastructure.

The municipality is working with the Province of Noord-Holland, local authorities, harbour administrators, energy network administrators and industry in the North Sea Canal Area, one of the five energy-intensive clusters in the Netherlands. Companies from the North Sea Canal Area exchange knowledge on the TET platform (organised by ORAM), in order to accelerate innovation by presenting business cases and launching demo-projects.

We see an increase in the storage and production of biofuels, re-use of residual flows and use of waste heat

This will only succeed if...

The challenge for the Harbour & Industry path is to transform the harbour from being a fossil energy hub into a sustainable energy cluster. At present, we already see an increase in the storage and production of biofuels, re-use of residual flows and utilisation of waste heat. We also see the first initiatives developing in relation to hydrogen-based synthetic fuels, methanol and ammonia. These developments will be accelerated in the coming years, whilst coal and other fossil fuels will need to be phased out in the longer term. With a limited set of municipal instruments to exert influence on carbon emissions and the trade in fossil fuels, we have to take a different approach to achieve these ambitions; and an essential element of this is stable and intensive cooperation with the Port of Amsterdam, companies in the harbour area and regional partners.

2030-2050

CCSU

- Realisation of carbon capture plant at high-efficiency AEB power plant
- Inject CO_2 into empty gas fields in the North Sea
- Pilot and scale-up production of synthetic fuels
- Pilots for large-scale re-utilisation of CO_2

Steam network

- First companies linked up, further rollout
- First plans for geothermal heating

Hydrogen

- Before 2050, Hemweg power plant becomes fossil-free energy hub with sustainable electricity, heat, hydrogen and fuels
- Scale up electrolysis capacity based on offshore wind
- Import green hydrogen from sunny regions

2050

CCSU

- Large-scale production of synthetic fuels for climate-neutral shipping and aviation
- Intensify carbon capture at AEB and possibly also at other biomass energy plants to realise negative carbon emissions

Phase-out fossil

- Aim to phase out fossil cargo flows by 2050 and transform harbour into a renewable energy and fuel cluster

Peter Hoogendijk

Energy commissioner, Watergraafsmeer

"We've had a compost bin in our garden for three years. Someone gave me a handful of tiger worms, and we feed them with coffee dregs, vegetable and fruit peelings, and so on. It took a while for the kids to get used to separating the waste. When they threw an apple core in the waste bin, for example, I'd say, 'No, that's for the tigers!' It's fun and useful to make your own compost. You cut down on your rubbish and you get compost for the garden in return. I wrote a piece on our tiger worms for our neighbourhood paper, Dwars. Since then, at least 25 people have stopped by to get a handful of worms for their compost bins. It's great!"

"We're also working on making our home more sustainable. We've added a lot of insulation, for example, allowing us to cut our energy bill. We've got an induction stove, which I'm very satisfied with. It works really well; the kitchen is cleaner and the air in the house is fresher. We've got solar panels, too, and as the next step, I'd like to connect a hybrid heat pump to the boiler. That would really cut our gas use."

"It's good that we're phasing out natural gas quickly. The municipality is arranging the phase-out district by district. That's great, but it is important to involve residents in the process."

"Most people haven't made a start yet on phasing out natural gas in their homes. They are waiting to see what happens. The municipality is drawing up plans to disconnect homes from natural gas, district by district. It's a massive operation. I think that it's important for people to know what their options are, and in particular when it's going to be their district's turn. You really need to enthuse people, and make them feel that it's also their process."

Chapter 4
What needs to be done?

In this chapter, we look in more depth at the aspects that are crucial for a successful energy transition. If we are to achieve our goals, certain preconditions will need to be in place, even if they do not directly result in carbon reductions. They include support and collaboration, the development and exchange of knowledge, capacity and financing, and last but not least, working to achieve a fair transition in which all citizens of Amsterdam can participate.

4.1

Amsterdam works together

Everyone will be affected by the energy transition at some point. Residents, entrepreneurs, corporations, research institutions: we all have a part to play. That is because change is always a combination of individual choices and top-down, collective, system-changing decisions. With the Amsterdam Climate Agreement, we have created a broad alliance to support the transition to a climate-neutral city. In partnership with the city, we are building an ever-expanding movement in Amsterdam: the New Amsterdam Climate platform. We are working together to save energy, generate more sustainable energy, and raise awareness and increase support.

Pillar 17
Building the movement in the city

Building the movement is all about showing people how to take concrete action. As the transition unfolds, we will ensure that everyone receives as much help and reassurance as possible. We are also learning about the collective solutions that Amsterdam's citizens need, so we can improve our service provision and instruments. All developments relating to sustainability will be presented on the New Amsterdam Climate platform. In this way, the movement will be showcased and all citizens will be able to contribute in a way that suits them. The New Amsterdam Climate platform was launched by the municipality, but it belongs to the city.

Insights from climate and behavioural psychology play an important role in implementing this pillar. They teach us that in order to change behaviour, it is not only necessary to inform people, but also to inspire them, encourage them, and above all: help to show Amsterdam's citizens what they can do already to make a difference. This is consistent with recent research findings (OIS, 2019) that show that while most citizens are aware of climate change, they are uncertain about what it means for their everyday lives.

We all have different motives; whereas one person might be enthused by the vision of a cleaner city for their children, another might be motivated primarily by the prospect of a cosy home or a cheaper energy bill. The aim of the activities in this pillar is to showcase, strengthen, accelerate, scale up and broaden the movement towards a climate-neutral city.

We will cover four key issues:

1. Supporting citizens who want to get working on the transition
2. Supporting frontrunners
3. The New Amsterdam Climate online platform
4. Improving municipal service provision and instruments

1 Supporting citizens who want to get working on the transition

We are creating space for citizens who want to get started on making their homes, streets, neighbourhoods or districts more sustainable. We are boosting local ownership of the energy supply and sustainable transport solutions. This includes solar panels, collective management of heat distribution grids, local energy markets and shared electric vehicles. At present, many citizens are still experimenting with small-scale versions of future energy supply systems.

Building the movement is all about showing people how to take concrete action

Scaling up will require new forms of ownership, financing and collaboration, and a new role for the government. We will help to develop initiatives that can also be followed elsewhere in the city.

We will continue to research how we can assist and motivate citizens who have yet to take the first step. To do this, among other things, we are launching research, in partnership with the Amsterdam University of Applied Sciences, into what different groups of citizens need in order to act. We will also continue with the current Step2Save, Energiecoaches, !WOON and Vroeg Eropaf projects, which combine awareness-raising with energy-saving measures in homes. These projects will be evaluated in 2020.

Diverse forms of support

We are helping citizens who want to take action by providing technical, organisational and sometimes financial assistance and advice. This is offered both online and offline, for example with subsidies and online tools on the New Amsterdam Climate platform: nieuwamsterdamsklimaat.nl.

More and more information is being made available online. For more complex initiatives, however, personal, tailormade advice and supervision from a sustainable initiative coach often brings great added value. We are working closely on this with the regional energy help-desk (Regionaal Energieloket), which gives homeowners technical advice on greening their homes, and with !WOON, which supports tenants and mixed owner-occupier associations. We are approaching neighbourhoods, groups and organisations with relatively high carbon emissions or considerable potential to reduce emissions, with offers of assistance. When this seems promising, we link small initiatives and neighbourhood organisations to larger initiatives, collectives and institutes.

Verifiable agreements

With parties that are receptive to this, we make agreements – preferably measurable and verifiable ones – on cutting carbon emissions, clean energy generation or increasing support for the energy transition. These agreements are put on the New Amsterdam Climate platform.

We are creating space for citizens who want to start working on sustainability

2 Supporting frontrunners

Amsterdam is home to a large and diverse network of frontrunners: people who dedicate much (personal) time and effort to greening the city and encouraging others. These frontrunners play a crucial role in driving the transition. They break new ground with innovative solutions, share the knowledge and experience they've gained, and inspire less advanced groups to take action.

Frontrunners can have a considerable impact, certainly if their initiatives gain a collective character. One example is that of energy cooperatives, which are multiplying rapidly. Together with their members (residents of Amsterdam) and energy companies, grid operators and owners of large roofs or datacentres, they are building sustainable, local energy systems. Examples include large solar roofs and heat distribution grids that use waste heat from datacentres.

The municipality is supporting frontrunners by showcasing their initiatives, for example on the New Amsterdam Climate platform, and by helping them with knowledge, skills and resources. Together with frontrunners, we are looking at where we can remove obstacles that may be impeding initiatives. To support frontrunners, the municipality is working in close partnership with a network of initiators, 02025 (02025.nl).

3 The new Amsterdam Climate online platform

The New Amsterdam Climate platform (nieuwamsterdamsklimaat.nl) helps and encourages citizens to take steps to save energy and generate clean energy. The ambition is for the platform to develop

over time into a 'one-stop-shop' for sustainability, aimed at citizens who want to build a clean, healthy city. It was launched by the Municipality of Amsterdam, which develops and manages the platform for and with the city.

Practical assistance

The New Amsterdam Climate website will offer citizens an increasing amount of practical assistance with getting started. This includes a rapid-assistance tool to help citizens find out how to invest in solar energy, a step-by-step sustainability plan for owner-occupier associations, and an app to help families make sustainable changes at home and in everyday life (Energy Challenge). The platform also offers simple, accessible tips, such as buying LED lightbulbs, turning down the central heating at night, or applying for free advice from a !WOON energy coach.

Inspiration

The New Amsterdam Climate website showcases the city's sustainability movement. We do this by mapping out initiatives and providing a platform for initiators (from individual citizens to companies and collectives) to share their stories in words and images. This works two ways: it puts the initiator in the spotlight and also inspires fellow citizens to take action. Knowledge and experiences are shared. The message for the reader is always that lots of citizens have already made a start, so you should, too!

Almost 200 initiatives are already covered on the platform: small and large, new and more established. It offers insight into many local neighbourhood initiatives, as well as the plans of large businesses and institutions, such as the Port of Amsterdam, Waternet and Artis Zoo. In partnership with the municipality, Artis Zoo is researching geothermal heating as a sustainable heat supply. With parties such as the Port of Amsterdam and ORAM, the municipality is developing a green hydrogen cluster. We are constantly adding new projects and stories to the New Amsterdam Climate website.

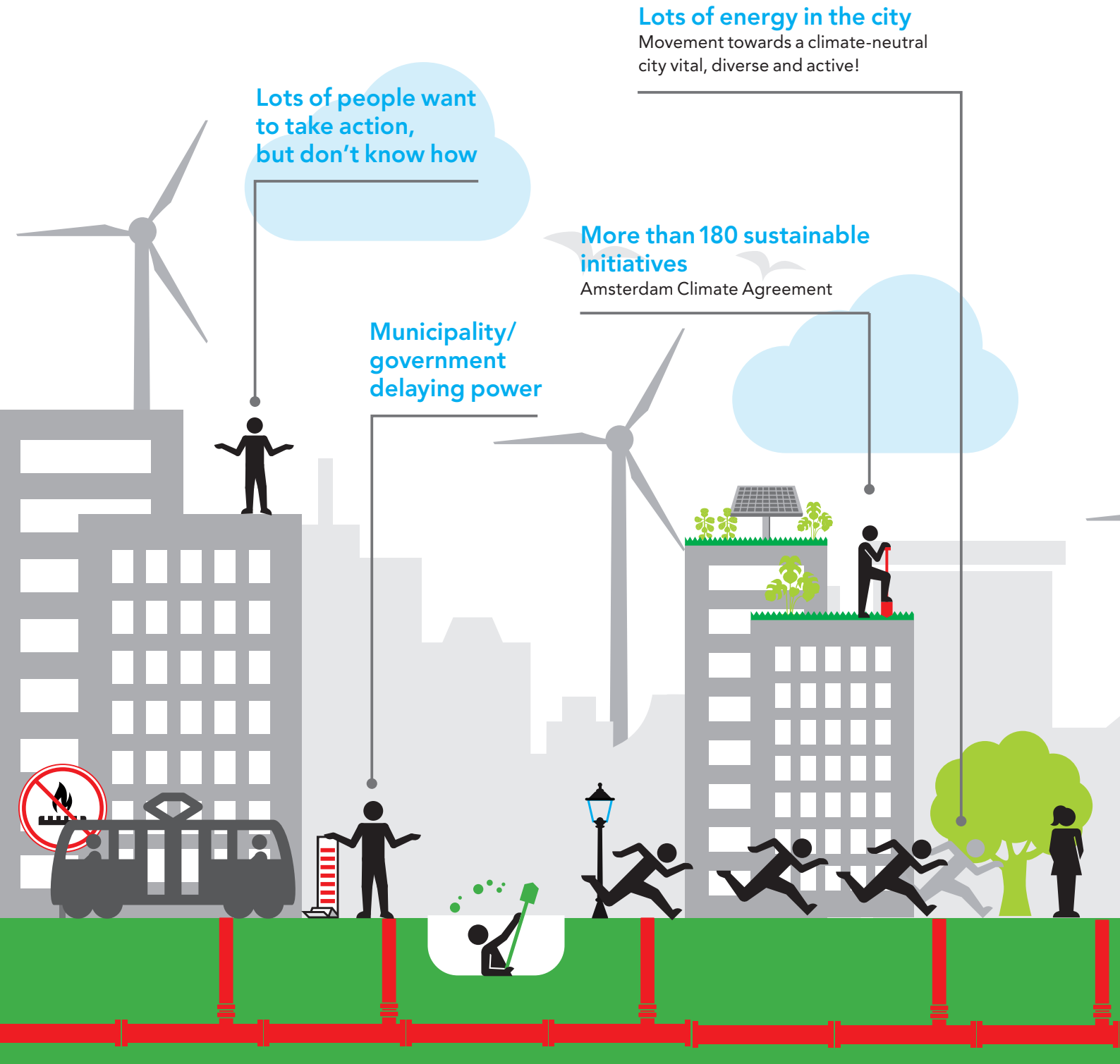
The conversation with the city

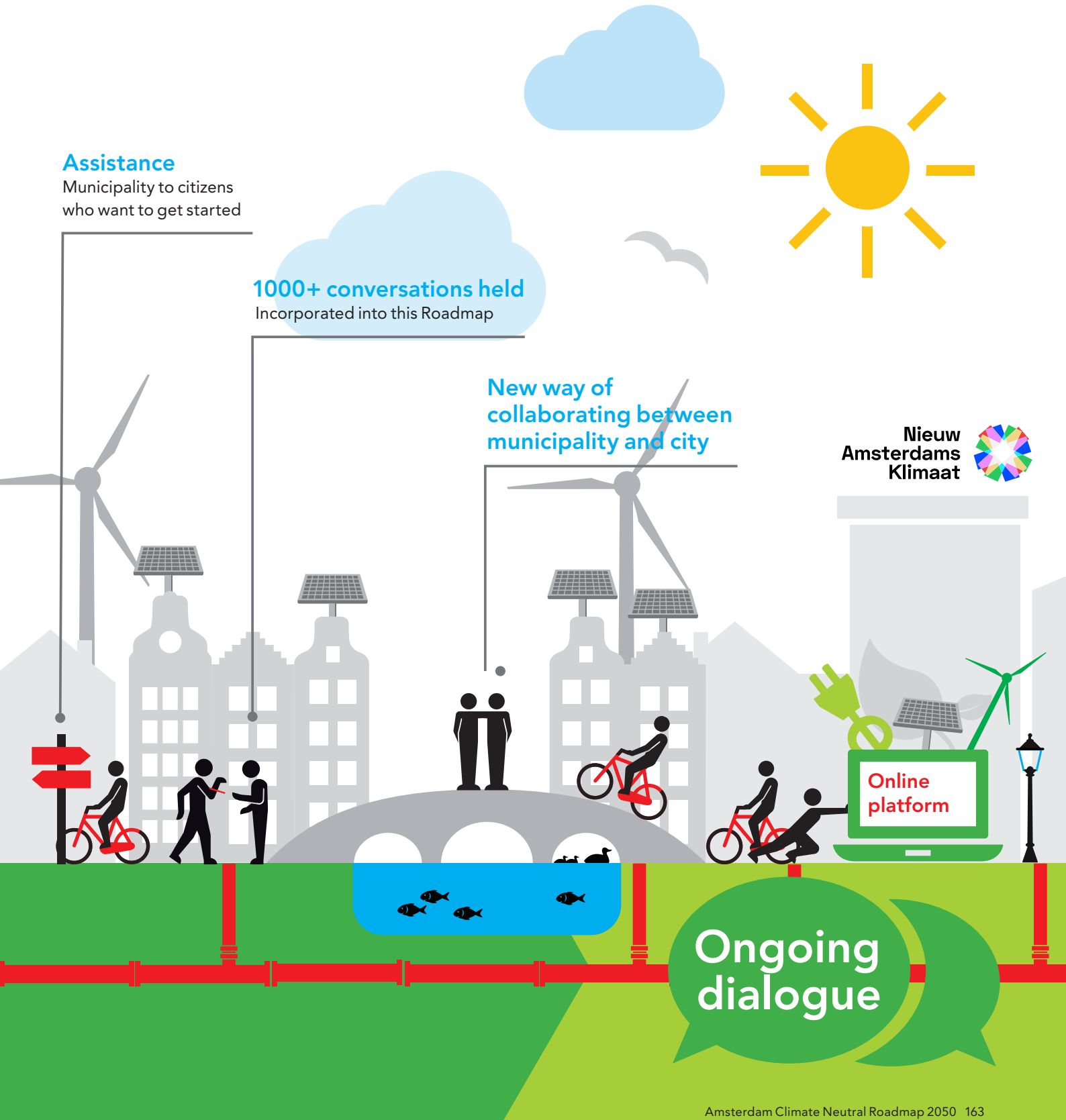
New Amsterdam Climate was the result of a series of more than 1,000 conversations that we held with citizens in 2019. This 'conversation with the city' was announced in the first Amsterdam Climate Neutral Roadmap, which was published in early 2019 with the subtitle An invitation to the city. These conversations were held across the whole extent of Amsterdam society: shopkeepers, residents, owner-occupier associations, large and small businesses, sports associations, museums, hospitals, industry, energy cooperatives, churches, neighbourhood associations, and many more. It became clear that the energy transition from below was already well underway.

The conversations resulted in the Amsterdam Climate Agreement of June 2019: a city-wide alliance to work together towards a climate-neutral Amsterdam. The New Amsterdam Climate online platform was launched at the same time. In the Climate Agreement, residents, businesses, institutes and the municipality show what they are doing and want to do to make the city climate-neutral. The initiatives contribute to reducing carbon emissions by saving energy and generating clean energy, and increasing support for greening the city. The initiatives in the Climate Agreement are being developed in the New Amsterdam Climate movement.

The conversation with the city

An ongoing dialogue with Amsterdam's citizens




Assistance
Municipality to citizens
who want to get started
1000+ conversations held
Incorporated into this Roadmap
New way of
collaborating between
municipality and city
Nieuw
Amsterdams
Klimaat
Online
platform
Ongoing
dialogue

4 Improving municipal services and instruments

During the conversations with the city, we saw that as well as leading the energy transition, the authorities can also hold it back. For that reason, we will focus on helping initiators to tackle inconvenient regulations or laws. The ultimate aim is to get rid of these obstacles in practice. The municipality needs to be receptive to initiatives, if they are to succeed, and we must therefore adapt our regulations and procedures.

Rapid and skilled service provision, ownership, flexible resource use and access to resources are essential for citizens who want to take sustainability measures. We visit people at home, attend others' meetings and organise our own meetings. We answer questions, give advice, set out potential courses of action, remove barriers and monitor progress. Making information accessible via various channels (advisors, telephone or Internet) contributes to this.

In doing so, we work with partners who focus on specific target groups, areas or sectors. We also monitor whether our service provision and instruments are sufficient, and adjust them to the needs and experiences in the city.

This will be important if we want to facilitate a faster transition. In this process, we are constantly learning about what does and does not work, developing ideas about how rules and procedures can be made smarter, and producing new insights that can be included in the updated Roadmap in 2020. When rules – or the lack of them – prove to be obstructive, we search for solutions.

The effectiveness of the municipal organisation will stand or fall with the quality of mutual cooperation and communication, and the government's capacity to act flexibly in a complex system, and its ability to facilitate the system as a whole as effectively as possible when faced with the challenges of the transition. In this complex reality with new forms of cooperation, the municipality will also have to change roles more often than in the past. Within the municipality, we will need to cooperate increasingly effectively in order to provide adequate services. Whereas information and service provision were often fragmented in the past, they are now becoming more and more streamlined.

The New Amsterdam Climate platform showcases the sustainability movement in the city

The accessibility of our services is based on Amsterdam's policy on service provision. Citizens contact the municipality with questions and ideas via various channels: by phone, email, social media or in person. The basic principle is that citizens should be assisted by a specialised member of staff as quickly as possible.

Our service provision

Services relating to sustainability take different forms: information and advice, financing and regulation. Regulation can promote and simplify sustainable developments. The municipality's options in this area are explained below in section 4.6 on 'Regulations'.

Information and advice

The greening of the city covers many different aspects. There is presently fragmented communication and information provision on topics such as the natural gas phase-out, circularity, climate adaptation, mobility, green roofs, the installation of solar panels, wind farms, the Regional Energy Strategy, the heat transition, saving energy in buildings, and so forth. Information is not always imitable, especially for citizens who want to take a coordinated approach in their neighbourhood. We will streamline this communication and information.

Financing

The municipality has a diverse range of financial instruments to facilitate initiatives in the city, including subsidies, loans and tax cuts. Measures linked to ground leasing and land allocation, contracting and purchasing, guarantees and participations can

also contribute to a climate-neutral city. Initiators can apply for these instruments, and we regularly test to see whether the instruments are still consistent with the needs and opportunities in the city. Faced with new opportunities, we develop new instruments.

The Amsterdam Climate Fund is intended to encourage residents, businesses and institutions to take significant measures to reduce carbon emissions, including disconnecting buildings from natural gas. In the case that projects do not pay for themselves (inevitable losses), initiators can apply for a contribution from the Climate Fund (see also section 4.5 on 'Financing').

The Climate Fund aims to encourage residents, companies and institutions to take significant measures to cut carbon emissions

Actions and measures

Research triggers for sustainable action in the Indische Buurt, in partnership with the Amsterdam University of Applied Sciences and the Samen Vooruit neighbourhood initiative

Evaluate collective purchasing schemes for solar energy and home insulation

Hold an active, continuous conversation with the city

Hold conversation with the city with other parties as part of the New Amsterdam Climate movement

Collaborate with 02025's 'energy breakfasts' and consultation sessions

Offer support to citizens who want to take sustainable measures

Option of applying for a subsidy for a sustainable project or programme

Owner-occupiers can visit the regional energy help-desk for advice about sustainability

Tenants can go to !WOON for support with making their homes sustainable

Citizens get advice from 02025.nl for collective sustainability campaigns

Assistance for parties with large emissions to reduce carbon emissions

Agreements with businesses and institutions on carbon emission cuts, sustainable generation or increasing support

Continue to develop the nieuwamsterdamsklimaat.nl platform

Give frontrunners a platform and help them to take the next step, in partnership with 02025

Develop action plan for people who want to install solar panels (*Zon Zonder Zorgen*)

Develop action plan for owner-occupier associations to develop large, sustainable, multi-annual renovation plans

Climate justice

The consequences of the city's transition from fossil fuels to renewable energy will not be equal for everyone. Some residents or neighbourhoods are more vulnerable or will benefit less from the opportunities offered by the energy transition. For the Municipality of Amsterdam, climate justice will form the guiding principle.

Pillar 18
Working towards a fair energy transition

In practice, we are implementing the principle of climate justice in three ways: by distributing the costs and benefits fairly, providing open access to the decision-making process, and creating equal opportunities in a changing job market.

1 A fair distribution of costs and benefits

We are paying extra attention to the target group of citizens with low- and middle-incomes, to ensure that the costs of the energy transition are not distributed unfairly. For this reason, the coalition agreement states that the living expenses of low- and middle-income households should not rise as a result of the transition. This principle is also reflected in the recently concluded cooperation agreements 2020-2023, which the municipality made with housing corporations and tenants. In addition, Amsterdam's ambition to phase out natural gas completely goes further than the national ambition (by 2040 for Amsterdam vs. 2050 nationally). This ambition is partly driven by the desire to shield lower-income households from high(er) gas prices.

Energy poverty

Energy poverty occurs when more than 10% of a household's net income is spent on energy consumption costs. The number of households in Amsterdam affected by energy poverty is rising. On the one hand, because the housing stock is aging and not always maintained properly, meaning that heat escapes through cracks in windows and doors. On the other hand, because there are more citizens with less spending power. In addition to current initiatives to help households cut their energy bills, we are investigating which additional measures will be needed to counter energy poverty as part of the transition.

What are we going to do?

Energy coaches

The deployment of energy coaches is one way to combat energy poverty. Three projects give energy advice to residents, along with a (free) box of savings products. This gives residents the knowledge and resources they need to make savings on their energy bills. The intended savings are €100 per year per household, on average. The following projects are underway in the city:

- **Project Energieadvies, run by Vroeg Eropaf:** as well as energy advice, residents are given a free box of savings products.
- **Project Step2Save:** the long-term unemployed in Amsterdam are trained to become energy coaches and visit people on low incomes. They also deliver boxes containing savings products. This project

Roof-generated solar energy will be made available to Amsterdam's minimum wage-earners

is being run in partnership with Vattenfall, the Werkgevers Servicepunt Groot Amsterdam (WSP) and city district Zuid.

- **Project Energiecoaches**: !WOON has been commissioned by the municipality to provide advice on how to save energy at home, on request.

Solar panels and rented social housing

Based on the cooperation agreements with housing corporations, discussions are currently being held on the greening of (social) housing complexes. Installing solar panels on complex roofs is an important element of this. In the talks with housing corporations on the installation of solar panels, we will allow for the fact that tenants (in social housing) should benefit as much as possible from the proceeds.

2 Open access to the decision-making process

It is important for all citizens to be able to contribute their thoughts, ideas and actions in the energy transition. This will require additional efforts. The diversity of the city must be reflected in the conversation with the city, which must be held appropriately. For this reason, we are working on more intensive cooperation with the democratisation and participation team and the Chief Technology Office (CTO) to test and develop shared tools and methods that could contribute to this. In the run-up to the new participation regulations, we will test ways of reaching out to diverse groups in the city. We are also developing a Right to Challenge, in partnership with the democratisation team (Team Democratisering).

Ma.ak020 agreement and neighbourhood budgets

The social agreement for Amsterdam (Ma.ak020 agreement) offers opportunities and starting points for entering into discussions with social parties and partners that, together with their networks in the city, have a great interest in the energy transition and ideas for putting it into practice. The neighbourhood budget approach also offers residents the possibility of submitting plans and initiatives for implementing ideas.

The municipality is working on an implementation plan for an employment approach known as the Green New Deal

The commons approach and energy democracy

The energy transition presents a great opportunity for further democratisation. A 'commons' is a commonly-owned and managed resource, like those we see in the field of energy cooperation. For example, the construction, management and yield of a wind turbine/solar farm/distribution network can be based on a market model or on the commons. In the latter case, it is the users – who are also the owners – and the local economy that benefit from the proceeds.

By seeing energy as a common good and managing it as such, we can create opportunities for the generation, distribution and consumption of energy. The National Climate Agreement, for example, sets a target of '50% local ownership of renewable energy', and the concepts of the 'renewable energy community' and 'citizen energy community' are recognised in Europe. We are currently investigating how Amsterdam could do more in this area, with the aim of having the surroundings benefit from a considerable share of the proceeds.

Research by the Amsterdam University of Applied Sciences and Samen Vooruit in Oost

In practice, there is a wide gulf between concern about the environment and sustainable behaviour in practice. When it comes to green behaviour, having a specific notion of what we need to do seems to be the first step in increasing self-effectiveness. The Samen Vooruit residents' initiative, which is based in the Indische Buurt, consists of a group of active residents who want to promote the city's climate-neutral ambitions in the district. Together with the Amsterdam University of Applied Sciences, they will carry out research in 2020. Based

on this research, the Amsterdam University of Applied Sciences, the Municipality of Amsterdam and Samen Vooruit want to develop specific proposals for different types of residents and search for (positive) triggers that induce residents to act sustainably. The insights from the study will be translated into an inventory of realistic green behaviours and motivating triggers. This inventory and the practical experiences in the Indische Buurt can subsequently serve as an example for other districts in Amsterdam.

3 Fair opportunities in a changing job market

In partnership with employers, trades unions and educational institutions, the municipality wants to develop new and updated training, work-study and employment paths, allowing more citizens to benefit from the investment in the energy transition. In the New Green Deal motion (10 July 2019), the Mayor and Cabinet are called upon to draw up a Green New Deal in partnership with (local) enterprises and education institutions, in which:

- Amsterdam's citizens find work in urban development, the energy transition, and the greening and maintenance of the city;
- More young people are trained for work in the sustainability sector;
- Local (neighbourhood) economies are strengthened;
- Cooperative forms of work are supported and encouraged.

What are we going to do?

Employment approach

The municipality is currently working on an implementation plan for employment known as the Green New Deal, which will be completed by the summer of 2020. We are aiming for more intensive cooperation between businesses, educational institutions and the municipality to develop broad training, work-study and employment paths, so that more citizens benefit from the investments relating to the energy transition. We will maximise coordination with the Metropolitan Region Amsterdam's (MRA's) Human Capital Agenda and the activities of House of Skills. The Human Capital Agenda focuses on training and work-study paths, but also on making technical education more attractive and the intake of workers who are currently economically inactive. The House of Skills is a public-private partnership in the MRA, in which businesses, sector organisations, employees' and employers' organisations, research institutes, education and administrators cooperate closely to transform the current job market into a more skills-focused job market.

We want to respond optimally to opportunities in order to help job-seekers find work in the sustainability sector

Opportunities for the long-term unemployed

In addition, the municipality wants to offer optimal opportunities to help job-seekers to find work in the sustainability sector. We are going to research how the social impact of all the investments that the municipality is making as part of the climate-neutral agenda can be magnified. For example, by looking critically at whether our investments and projects also create opportunities for work for citizens on benefits or the long-term unemployed. In order to facilitate this, the tasks that the municipality puts out should be designed, as far as possible, with a Social Return obligation focused on employment for job-seekers.

Strengthening intermediate vocational education (MBO)

In the autumn of 2019, Amsterdam City Council agreed an agenda for intermediate vocational education (*MBO Agenda*) that focuses on future-proof secondary vocational education with links to the job market. With the *MBO Agenda*, vocational education institutions and other partners want to contribute to major social issues in the city. Key themes include sustainability and technical skills shortages, and concrete measures include:

- Organising an information session (*kenniskamer*) on sustainability for MBO professionals.
- Setting up thematic working groups on sustainability and skills shortages (jointly by the four MBO institutions).
- Making an inventory of current sustainability initiatives: optional modules, education projects, public-private partnerships, and the course offering for retraining, further education and refresher training.
- Encouraging MBO institutions to introduce more innovative and shared sustainability projects for the *MBO Agenda* subsidy scheme.
- Strengthening MBO institutions to increase the influx onto technical courses.
- Broadening the initiative by the VTi technical training school, an Amsterdam-based public-private partnership that is well underway with training students for the energy transition. The new regional circular economy public-private partnership (Flevoland) also offers great potential.

We will develop and implement the Green New Deal approach to employment

Actions and measures

Carry out energy coach projects and research continued development

Investigate which additional measures are needed to combat energy poverty

Build on the Pact of Amsterdam meeting to combat energy poverty

Organise cooperation with housing corporations to ensure that tenants (in social housing) benefit from the generation of solar energy

Research the (positive) triggers that prompt residents to act sustainably, and use these to accelerate the process

Ensure open access to the decision-making process

Develop and implement the Green New Deal approach to employment

Implement the 'sustainability' key theme within the MBO Agenda, with the aim of including sustainability in the MBO curriculum and raising awareness among MBO students and teaching teams. Hold administrative board (*bestuurlijke tafel*) on the MBO Agenda for managing the MBO course offering on the energy transition

Learning and experimenting

The planned actions and measures that we set out in this Roadmap are expected to lead to a 48% reduction in carbon emissions by 2030. In order to achieve our ambition of a 55% cut in carbon emissions, additional measures will be needed. We will need to explore new paths and solutions in the coming years. We will need to innovate, but we can also learn a great deal from others. In doing so, we will need to innovate and exchange technical, social and economic knowledge. Cooperation with and between parties will be essential. We are looking at our own role, our methods, how we work with our partners, and the form that cooperation takes.

Pillar 19
Boosting knowledge development and sustainable innovation

We need space in order to exchange knowledge and learn from one other, try out new ideas, and discover what works and what does not: the city as an 'experimental plot for innovation'. In essence, this means giving each other the space and security to do things differently, in the shared knowledge that regardless of whether an experiment succeeds or fails, we will keep learning until we have found a way that works.

What are we going to do?

Learning from each other

Governments, businesses and expert institutes are all working to achieve the same aim of cutting carbon emissions. We can learn a great deal from each other by exchanging knowledge and working together on practical projects. This can be done at various levels. At the regional level, Amsterdam works with neighbouring municipalities and the province on the Regional Energy Strategy. This partnership offers good opportunities for greening transport, education, the job market and the economy. At the sustainability summit, administrators periodically discuss which themes to address at the level of the Metropolitan Region. As the capital of the Netherlands, Amsterdam is also internationally oriented. Our politicians and experts belong to networks that work on knowledge development, joint lobbying and international agenda-setting (see textbox on international knowledge exchange).

Drawing up a Knowledge and Innovation Agenda

Together with public and private partners, the Municipality of Amsterdam and the AMS Institute (Amsterdam Institute for Advanced Metropolitan Solutions) are launching a Knowledge and Innovation (K&I) Agenda on Climate and Energy.

This K&I Agenda draws together innovation issues relating to the climate-neutral city. It will be established in partnership with residents, the business community and expert institutes, and should provide insight into what is needed for a well-functioning innovation ecosystem in Amsterdam and the surrounding region. We will not innovate for innovation's sake, but follow a mission-driven innovation path: we are motivated by the objective, namely, to find new solutions to major social problems.

We cannot yet foresee what Amsterdam will have to do in the coming years. The K&I

The city as an experimental plot for innovation

Agenda is adjusted continuously where necessary, based on the results of previous research and experiments, and is receptive to questions from the city. The objective is to set out a range of potential action for parties and to achieve better cooperation, both public-private and public-public. We aim to keep working towards an implementation programme, with 'living labs' where solutions are tested in practice. This will be done in partnership with Amsterdam's residents, the network of the Amsterdam Economic Board, Amsterdam Smart City, the Metropolitan Region Amsterdam (MRA), EIT Climate-KIC, start-ups and SMEs, the business community, and investment funds such as Invest-MRA and the Amsterdam Climate Fund.

The municipality is working on implementing the K&I Agenda with the following research institutes: VU University Amsterdam, the University of Amsterdam, the Amsterdam University of Applied Sciences and the AMS Institute.

Actions and measures

Draw up a Knowledge and Innovation Agenda in partnership with the AMS Institute

Participate in collaborative European projects and global network of front-runner cities

International knowledge exchange

Three high-profile projects involve international cooperation: CityZEN, ATELIER and SEEV4City. In the EU Smart City project CityZEN, Amsterdam and Grenoble collaborated on a route to climate neutrality between 2014 and 2019. Twenty innovative pilot projects were undertaken, resulting in a reduction of 59,000 tons of CO2. One project involved using drinking water to cool Amsterdam's blood bank. The successor to CityZEN, the EU Lighthouse project ATELIER, was launched in the autumn of 2019. In this project, Amsterdam and Bilbao are working together to build an energy-supplying district in Buiksloterham. As part of the EU project SEEV4City, Amsterdam is working with grid operator Liander on smart charging solutions for electric cars. The aim of this project is to relieve the electricity grid and charge electric cars using sustainable electricity.

Amsterdam is also collaborating strategically with Climate KIC, the EU's innovation platform for scaling up proven climate solutions. The collaboration includes the 10,000 homes programme and the Green Light District.

When it comes to lobbying and agenda-setting at the European level, Amsterdam focuses on Eurocities, the network of European cities. Eurocities is the strategic partner of the European Commission in the EU Urban Agenda and an important representative of cities when lobbying Brussels. Amsterdam initiated and chaired the Eurocities Climate Strategy Roundtable and the taskforce on the Circular Economy (2016-2019).

Amsterdam also belongs to the C40, the international administrative network of cities. In this network, administrators of cities around the world support one another and set the tone for a (more) ambitious global climate policy.

Amsterdam recently joined a new network: the Carbon Neutral Cities Alliance (CNCA). The CNCA helps cities to learn from one another and share experiences. The CNCA brings together leading cities with clear climate policies and targets, including New York City, San Francisco, London, Copenhagen and Helsinki.

Amsterdam will continue to play an international role in future, and to call for an ambitious climate policy at the EU and around the world.

4.4

Space and infrastructure

In the coming decades, the energy transition will pose one of the greatest challenges in the city's spatial planning, both above and below ground. This is because the impact of the energy transition will have a major impact on the physical surroundings: it requires a lot of space, space is scarce, it will change the appearance of the city, and leadership is needed.

A lot of space will be needed, above and below ground

We need a new, adapted energy infrastructure for the generation, transport and delivery of electricity, heat, (green) gas, CO_2 and hydrogen. Although no one yet knows exactly what the sustainable energy system of the future will be like, we do know that different systems will co-exist during the transition. We also know that the new energy system will require more space than the current fossil-based system. The available space above and below ground will thus play a decisive role in the development of the new energy system.

Space is scarce

Space is scarce in a compact and growing city such as Amsterdam, both above and below ground. This cannot be seen in isolation from other claims on space, relating to other urban tasks. Take, for example, home-building or the changing transport system, the renovation of quays and bridges, the task of making the economy circular, climate adaption, underground car parks and the transport of refuse, biodiversity, and all of the cables that are needed to stream online data.

The appearance of the city will change

Our city and the surrounding landscape will look different as a result of the installations and infrastructure that are needed for the energy transition. Take wind turbines and solar panels, for example, but also the buildings and plants needed for heating and hydrogen. This will make the energy transition more visible and tangible in our surroundings; and this means that the energy transition is also a design challenge. By visualising and sketching out what the city could look like in future, we can make the energy transition more concrete, and hold discussions about we do and do not consider to be desirable.

In the coming decades, the energy transition will be one of the city's greatest spatial planning challenges

A major undertaking

Adapting the energy infrastructure will also be a major undertaking. How to install new heat distribution grids and strengthen electricity networks while keeping the city accessible is a complex puzzle, and this will require leadership from the municipality. We will search for opportunities and for smart and efficient combinations when carrying out the works.

The Spatial Vision

The new Spatial Vision for Amsterdam outlines a future vision of the city in 2050, and sets the course. By planning at various scale-levels with neighbouring municipalities, the province and the MRA, we make integral assessments and choices that lead to a high-quality environment. The Spatial Vision provides direction and guidance for the spatial translation of the energy transition. This Roadmap, the Regional Energy Strategy and the Transitievisie Warmte all provide input for the Spatial Vision. The Environmental Plan subsequently sets

out all of the options for regulating (and deregulating) and facilitating projects that contribute to the energy transition.

Pillar 20
Making space for the energy transition and infrastructure

The municipality plays a major role in spatial planning, the design and operation of public space, and the management of underground space. There is a need for a flexible strategy, in which we make the demand for space created by the energy transition increasingly specific. At present, we perceive nine challenges relating to the energy transition that need to be translated spatially in the Spatial Vision, spatial policy and planning.

1 Innovation and acceleration by citizens' initiatives and by challenging the market

Creating space (including physically!) for citizens' ideas will result in ownership, acceleration and support for the energy transition. See also pillar 17 on building the movement in the city.

2 All new-builds and transformation projects are at least energy-neutral

Energy-neutral is the new normal; we must not allow new buildings to add to the future task of cutting carbon emissions. This has implications for the appearance of buildings and areas. Unnecessary energy consumption will be avoided through the use of smart, green designs. The appearance of buildings will change, due to solar panels on facades or less glass being used on facades. See also pillar 7 on energy-neutral construction.

No one yet knows what exactly the sustainable energy system of the future will be like

3 No roof left unused

The first priority is to install solar panels on suitable roofs of both new and existing buildings (also in conservation areas and on monuments). We will also use opportunities for solar energy on facades, alongside railways and motorways, and on wasteland. Amsterdam has a total roof surface of around 6,000 hectares. Of this, c. 1,200 hectares (20% of all roofs) are suitable for the installation of solar panels. See also pillar 10 on rooftop solar energy.

4 Space for large-scale wind energy

The Regional Energy Strategy (RES) sets out search areas for large-scale wind energy. These are largely consistent with existing search areas, such as the areas outlined in the 2012 vision on wind. More space can also be found in built-up areas for small-scale local wind energy generation (including on roofs). See also pillar 11 on wind energy.

5 The right heating in the right place

The basic principle is to achieve an optimal match between the kind of heat that is needed to heat buildings and warm tap water and the quality of the buildings. We therefore prefer to use low-temperature heating (and networks) for well-insulated new buildings, and high-temperature heating for buildings that are more difficult to insulate, such as monuments. We also follow the basic principle that the heating infrastructure will be installed at the lowest possible cost to society. The Transitievisie Warmte sets out when natural gas will be phased out in each district, using which

preferred infrastructure. This is linked to other spatial issues in the districts concerned, such as the housing stock, public space, the organisation of the substratum and sustainability measures. See also pillars 1, 2 and 3 in the chapter on a natural gas-free built environment.

6 Limited car traffic in the city and zero-emissions transport

Limiting car traffic in the city and achieving zero-emissions transport will require a reorganisation of the transport network and physical space. This includes densification around public transport interchanges, investing in a more comprehensive and faster public transport network, and interchanges on the edges of the city for the transhipment of goods and people to smaller and cleaner vehicles in the city (by road and by water). But it also covers fewer parking places and more space for cyclists and pedestrians. Emissions-free transport will need a charging infrastructure (charging points, rapid charging stations, hydrogen filling stations and a robust and smart energy network). See also pillars 8 and 9 in the chapter on mobility.

7 Space for the energy transition in public space and under the ground

The energy transition will require the existing utilities infrastructure to be strengthened, expanded and adapted. We will need to pay considerable attention to installing this essential infrastructure. A growing part of the natural gas grid will fall into disuse, and heat distribution grids will expand and develop more diverse sources and applications. The electricity grid will gain more capacity. Innovation can be expected on all these fronts; this could include new forms of energy storage in residential areas, such as neighbourhood batteries, hydrogen or heat buffers. Energy infrastructures will become increasingly interlinked: from electricity to heat, from hydrogen to electricity, and vice versa. There will be increased management of energy-flow supply and demand. We are moving from a system of relatively flat, one-dimensional energy grids to integrated smart networks that provide energy for homes, work, industry and transport.

Energy infrastructures are also becoming increasingly interlinked: from electricity to heat, and from hydrogen to electricity, and vice versa

In any case, we know that a considerable amount of space will be needed for:

- Electricity infrastructure, substations, transformer houses, electricity storage, charging infrastructure for electric mobility, solar panels in public space (see also pillar 12 on the electricity infrastructure);
- Heating and cooling networks, heat exchangers, heat transfer stations, reserve space for (the installation of) geothermal wells, and thermal energy from surface water, sewage and drinking water (see also pillar 3 on the heat infrastructure);
- En CO_2 pipelines (see also pillar 15 on carbon capture).

This will require us to clear the substratum and remove cables and pipes that are no longer in use. We will also need to adopt innovative ways of carrying out works in the substratum, whereby different works are combined and cables and pipelines are clustered.

For the first time, the municipality is currently investigating space claims for utility provisions on the scale of the whole city, above and below ground, based on all municipal ambitions (municipal service provision). We need this insight – which is already much more developed for individual infrastructures – to be able to make integral assessments at the city level. The aim is for utilities to be given a spatially efficient, high-quality place in the city.

A vision of Amsterdam's substratum will be drawn up in 2020, putting forward explicit choices regarding the use of the substratum. The heat strategy (*Warmtestrategie*) will also be adopted in 2020, in which we set out how the necessary heat infrastructure and sustainable heat sources will be developed.

8 The harbour as a battery for the city and region

Amsterdam's harbour (including safety contours) occupies a strategic place in the changing local and global energy market. The harbour is a suitable location for the generation, storage and distribution of renewable energy for industry, aviation and shipping, the city and the region. In addition, the harbour can be transformed into a logistical hub for international renewable energy trade flows, such as hydrogen. The municipality wants to organise the spatial opportunities and the accompanying environmental regulations in line with this. See also pillars 13 and 14 in the chapter on the harbour and industry.

9 The city as a 'living lab'

New technologies and innovation play an essential role in extending and accelerating the energy transition. This will also require free space; in regulations, but also physically. Take, for example, experimental plots for new technologies and areas where citizens are given the space and time to experiment. We will ensure that the culture of 'building the city together' is structurally supported and developed. See pillar 19 on innovation.

In 2020, a vision of Amsterdam's substratum will be drawn up that sets out explicit choices for the use of the underground

Actions and measures

Adopt memo on the scope and level of detail of the Spatial Vision for Amsterdam

Carry out study on the substratum in the Spatial Vision

Develop Spatial Vision for Amsterdam

Implement utilities tasks

Strategic planning of works in public space and the substratum

Deliver integral design method for public space (*Ontwerpmethode Openbare Ruimte*)

Implement workplan for the substratum 2020

Research new forms of management of the substratum in 'Vol onder het maaiveld' process

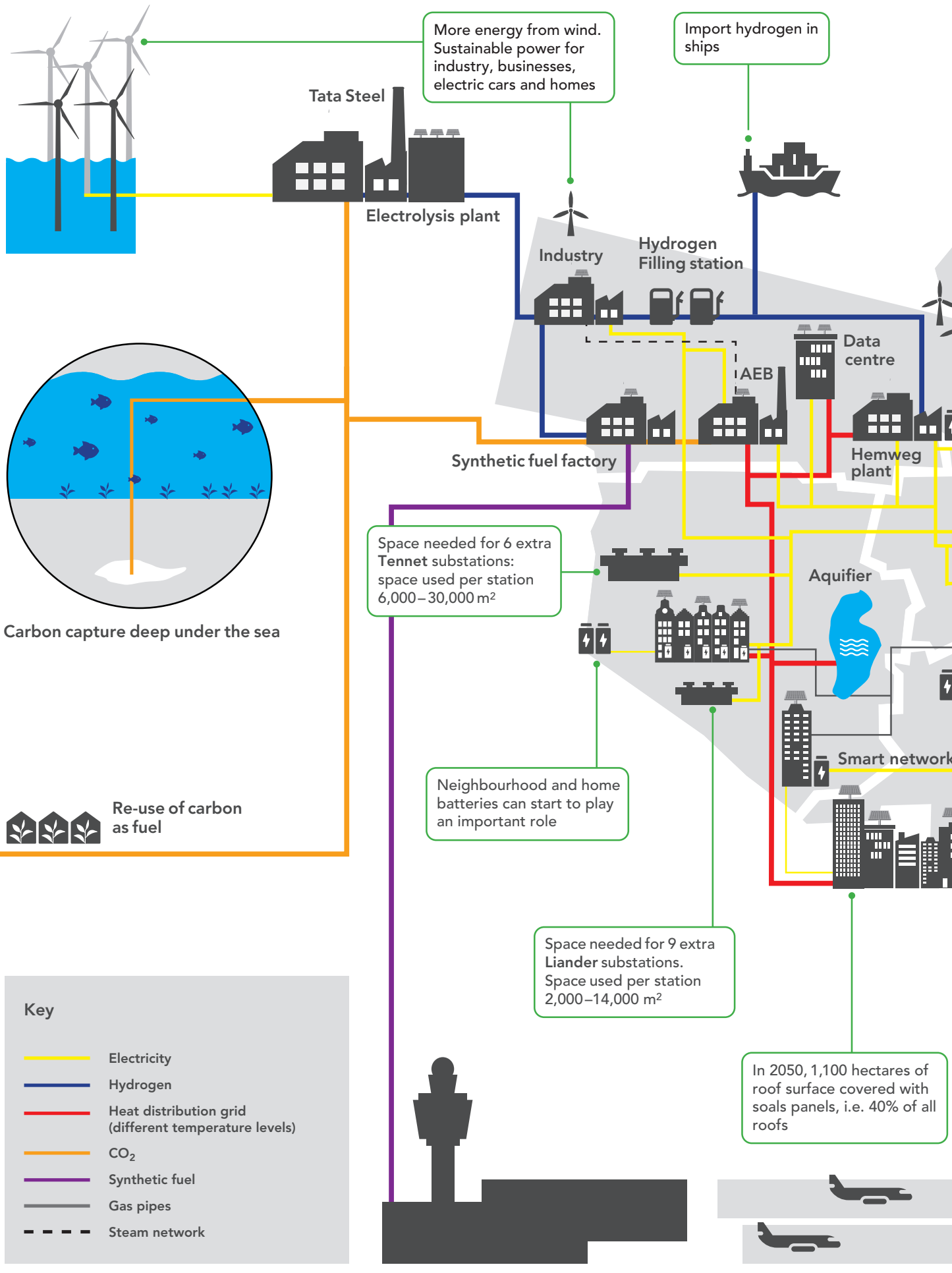
Implement 'Oranje loper' project (quick scan from the Palace on Dam Square to Mercatorplein)

Draw up heat exchanger masterplan(s) for large area developments

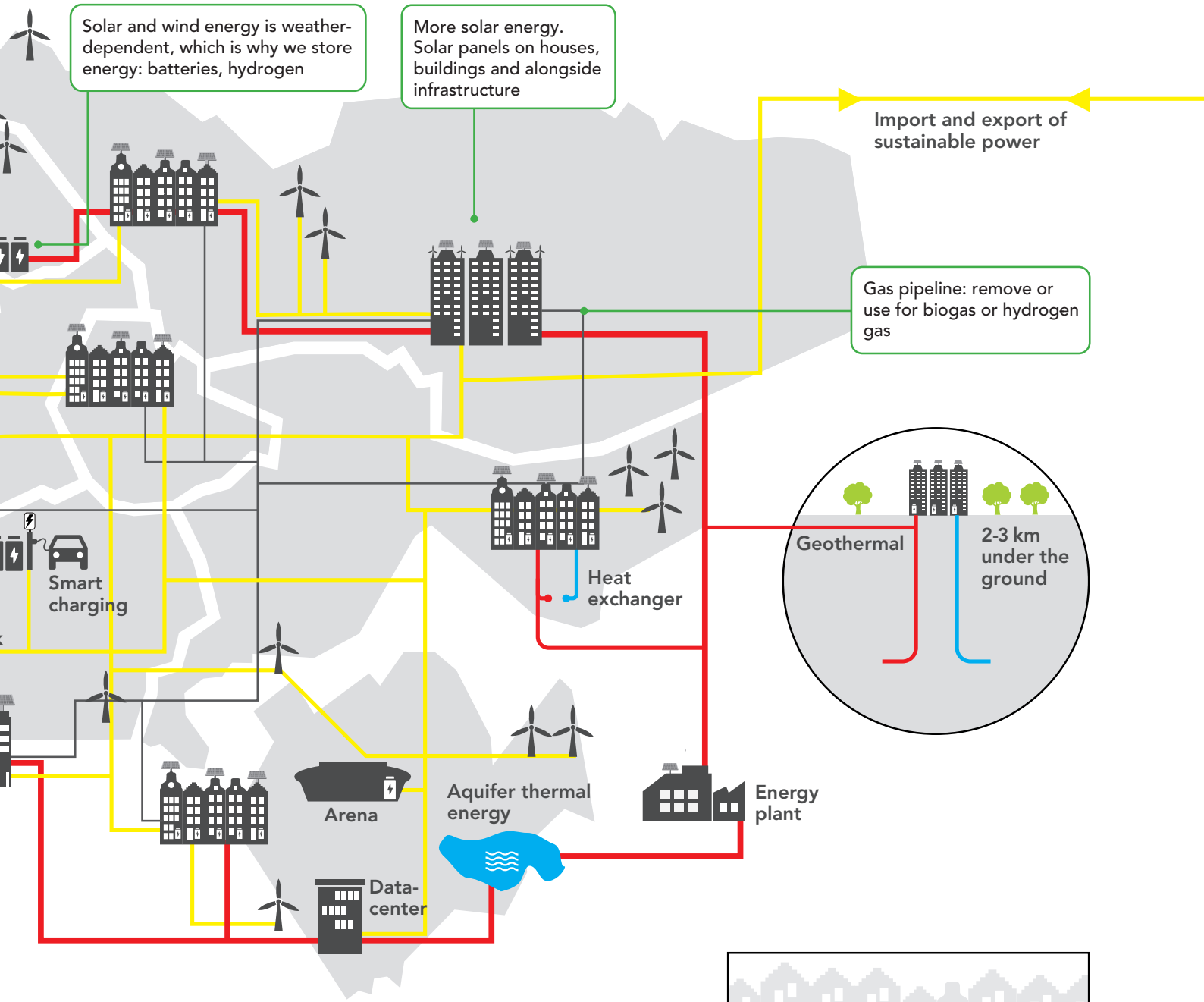
Knowledge exchange on sustainable public space and the substratum

Apply for EU subsidy focused on air quality and the climate-neutral city

Develop monitoring indicators for the spatial translation of the energy transition and energy infrastructure


More energy from wind. Sustainable power for industry, businesses, electric cars and homes
Import hydrogen in ships
Tata Steel
Electrolysis plant
Industry
Hydrogen Filling station
Data centre
AEB
Hemweg plant
Synthetic fuel factory
Space needed for 6 extra Tennet substations: space used per station 6,000–30,000 m²
Aquifer
Carbon capture deep under the sea
Re-use of carbon as fuel
Neighbourhood and home batteries can start to play an important role
Smart network
Space needed for 9 extra Liander substations. Space used per station 2,000–14,000 m²
In 2050, 1,100 hectares of roof surface covered with soals panels, i.e. 40% of all roofs
Key
Electricity
Hydrogen
Heat distribution grid (different temperature levels)
CO2
Synthetic fuel
Gas pipes
Steam network

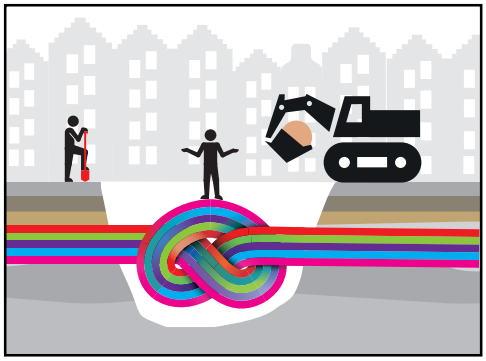
Space for the energy transition and infrastructure, Amsterdam 2050



'Vol onder het maaiveld'

The substratum is becoming more crowded as a result of all of the city's activities and ambitions. Space is becoming increasingly tight.

Works in the ground and public space are becoming more complex and expensive. Good management of the substratum and public space is a precondition for a successful energy transition.



4.5

Financing

One of the preconditions for the transition, and thus for the measures described above, is having resources available. Transforming Amsterdam into a climate-neutral city will require billions in investment before 2050. For example, investment is needed to phase out natural gas in Amsterdam, create new sources of heat, adapt buildings, and for large-scale interventions in infrastructure, the substratum and public space.

The financial resources should be provided by both government and by society. The share that is covered by the municipal budget will gradually become clearer.

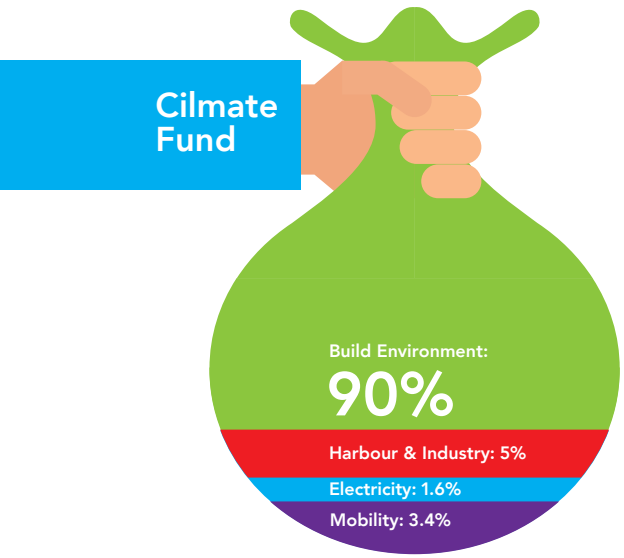
The Climate Fund was established by Amsterdam City Council on 13 February 2019, and has a budget of €150 million. The Council decision also established a spending outlook for the Climate Fund. This gives an indication of how the sum can be distributed across the different transition paths: the Built Environment Mobility, Electricity, and Harbour & Industry. It describes the basic principles and criteria for spending the funds. The Mayor and Cabinet establish the in-depth spending outlook for the Climate Fund. A specific financial strategy has been developed for each transition path. The financial strategy is indicative and directional, but not determinative; the aim is to provide space for current developments. After all, we do not know enough about where the opportunities will lie. Should unique, innovative situations arise that help us to meet our targets, our response should not be limited by current frameworks.

Making Amsterdam climate-neutral is a task that will require billions in investment before 2050

At the same time, we are working with central government to ensure that more money is made available to make the entire building stock natural gas-free, and we are urging the government to adapt legislation, regulations and market regulation to aid the transition.

In order to meet our targets, more and more financial resources will also be made available outside Amsterdam, also for use in Amsterdam. For example, resources are available from companies and financial institutions, the Metropolitan Region Amsterdam, the province, and international and other funds, such as Invest-NL, Invest-MRA and EU funds. The release of many of these resources will be conditional on municipal co-financing or sponsorship. In addition, the provision of resources is often accompanied by an extensive application and accountability process that takes considerable capacity.

In 2020, the municipality will start to create a more detailed overview of these financial options beyond Amsterdam, and we aim to make optimal use of these.



Project in the spotlight

The transition to a fossil-fuel-free Hemweg site in 2050

Now that the coal-fired plant has closed, in the coming years Vattenfall will develop the Hemweg site into a clean energy hub. Vattenfall director Alexander van Ofwegen outlines the transition to a fossil-fuel-free site in 2050.

"The Hemweg site will soon form the key link in the generation and distribution of clean energy in the Amsterdam region", explains Alexander. "The transition is taking four paths: the first is the green electricity path. For this, the gas-powered plant on site is being converted into a plant that generates power from green hydrogen. From 2030, natural gas will be mixed with green hydrogen. The switch to 100% green hydrogen can only take place in 2035: there first needs to be enough green hydrogen, and the gas infrastructure also needs to be adapted."

In addition to hydrogen, the solar panels and wind turbines at Hemweg will also deliver green power. The site will thereby function as a fossil-fuel-free 'hub', where offshore wind power will simultaneously be transmitted to the city via the plant. "The second transition path concerns the production of green heat", Alexander continues. "From 2023, we will be installing e-boilers at the Hemweg site, which will deliver district heating based on green electricity from solar panels and wind turbines."

"Third, the Hemweg site will serve as an energy buffer for a stable grid. In addition to electrical storage in battery systems, hydrogen is an excellent way to store energy. When there's a surplus, we can store the energy and reuse it. This means that there will always be enough power and heat available for the region."

"Finally, the Hemweg plant and the Hemhavens will be the centre for the production of green hydrogen and synthetic fuels in the future. Schiphol currently uses 4.3 million tons of kerosene each year, 100% of which is produced by oil refineries. If this quantity of fossil fuel is mixed in the coming years to produce a 50% fossil-free-produced, synthetic fuel, then we will have an impact on reducing CO_2 emissions!"

Regulations

Making Amsterdam climate-neutral is not a voluntary undertaking; there is an urgent need to act quickly. Amsterdam's citizens usually decide for themselves whether to act, with the municipality playing an encouraging and facilitating role. But regulations are increasingly transforming voluntary actions into mandatory ones. Take, for instance, mandatory energy-savings for companies, environmental zones for polluting vehicles, standards for energy-neutral construction, or the eventual obligation to disconnect from the natural gas grid. From 2021, the Environment and Planning Act will provide municipalities with more steering options, including in the Environmental Plan. When such options are lacking, we will call on central government for suitable legislation and regulations.

Suitable state and EU legislation and regulations

Amsterdam wants to be one of the front-runners. To achieve this, it is essential that we create enough support and implement the transition fairly. A number of national and EU preconditions on financing, law and regulations, the tax regime, and discretionary space for local policy and considerations will be crucial for local implementation of the National Climate Agreement, our carbon-reduction targets and the natural gas phase-out. Where these are lacking, we will lobby central government and the EU.

The municipality is responsible for coordinating the energy transition. The transition can be accelerated by effective legislation and international support – and we need central government and the EU for this (see textbox on lobbying central government and the EU). When lobbying central government and the EU, we will build on shared interests with the G4 municipalities, the Association of Netherlands Municipalities, the Metropolitan Region and other local authorities, and also with key partners such as the Regional Agency for the Environment, Alliander, the parties to the City Deal Amsterdam Natural Gas-Free, and supporters of the Amsterdam Climate Agreement.

The municipality is responsible for coordinating the energy transition; effective legislation and national support can accelerate the transition

Reporting obstructive rules

Rules can also have an obstructive effect. Residents and companies sometimes lose their way in the municipal bureaucracy, meaning that their sustainable initiative or plan is delayed or fails to get off the ground altogether. This is also an issue that comes up in the contact that our initiative coaches have with Amsterdam's citizens.

The coalition agreement *Een nieuwe lente en een nieuw geluid* [A new spring and a new voice] (May 2018) states that: "We will investigate the obstacles that regulations present to sustainability measures and greening. A help-desk will be established, where Amsterdam's citizens can report these 'dirty rules'."

In order to become more receptive to these voices and offer tailormade guidance, we will take the following approach:

- The online platform nieuwamsterdamsklimaat.nl and the email address klimaatneutraal@amsterdam.nl have been established and are intended for questions and reports about obstacles to sustainability. We can be reached by phone on 14020.
- During discussions and meetings in the city, we expressly ask people about their experience with obstructive rules or processes.

- Since mid-2019, a number of initiative coaches have been working in the city to support sustainable initiatives and provide advice. They function as a first point of call, have a good network in the city and the municipality, and have the right mentality to find sustainable solutions. Where necessary, they scale up.
- We also get signals from partners in the city who offer advice, coaching and information, or who are involved in location policy or enforcement.
- The signals that we get from the channels above are monitored centrally (initiative board). If we discover a red line, not only do we offer a tailormade solution, but we also draw attention to structural solutions in the municipal organisation, municipal service provision, and when lobbying central government and the EU.

Insights to date

The reports and signals that we receive via these channels are registered and addressed where possible. In practice, we mostly receive questions about how to negotiate the municipal organisation, the issuing of permits for monuments and in conservation areas, finding information or advice, financial support, and the municipality's organisational capacity.

Lobbying central government and the EU

Amsterdam will continue to lobby central government and the EU, and intensify its efforts in relation to the following:

- Phasing out natural gas in the city. Take the application of the Heating Act, for example. Amsterdam advocates a form of market organisation in which municipalities play a central role, with open grids and a pricing system other than one linked to the gas price.
- Expand the investment space for corporations by abolishing the landlord levy, and use this to make the existing housing stock more sustainable, among other things.
- Organise sufficient capacity in the electricity grid to allow for rising consumption and an increase in the amount of sustainably-generated electricity. Solar panels should be installed on all suitable roofs, and adequate legislation is needed for this. At the same time, the electricity grid must be able to cope with growing supply and demand. Additional measures will be needed for this, such as net operators being able to make pre-investments and boosting the storage of electricity.
- The harbour's transformation into a suitable location for generating, storing and distributing renewable energy sources for the city and the region. The municipality has a limited set of instruments to compel carbon cuts and energy savings in industry and the harbour. National and international frameworks play a leading role here (such as a generic carbon tax), which is why we are expressly seeking cooperation on this issue with central government and the EU. In 2020, we will explore how Amsterdam's harbour can function as a sustainable battery for the city, and how central government and the EU can contribute to this.
- A fair distribution of the costs and benefits, achieved through carbon pricing, stable living expenses for low- and middle-income households, and local employment opportunities for the long-term unemployed, among other things. The task must be feasible and affordable. Extra money from central government is needed to cover the costs of implementing the National Climate Agreement and financing inevitable losses when natural gas is phased out in the city. Central government can contribute to this with focused use of the Investment Fund.
- An ambitious EU policy, because in the absence of clear, sharp targets, ambitious cities cannot develop enough implementation power on their own.

Project in the spotlight

Solar panels on eighteen school roofs in Amsterdam

Since the spring of 2019, eighteen schools in Amsterdam Nieuw-West have been generating their own clean energy. Their energy bills have halved as a result.

The school boards of the AMOS, ASKO, Esprit, Progresso, Westelijke Tuinsteden and ZAAM schools jointly installed around 6,000 solar panels. The driving force behind the project was Joke Middelbeek, who sits on the board of the Westelijke Tuinsteden foundation. It was Joke who came up with the idea. "At exactly the right time!", says Joke. "The roofs in Nieuw-West were empty. The municipality was promoting solar panels and I was building six new school buildings, so it could be done immediately. And there were subsidies."

"In this project, the school boards worked together to investigate the options for installing solar panels on our school roofs. By putting out a joint contract, we were able to achieve a great result. Several pupils are now calculating what needs to be done to make the schools 100% energy-neutral. This boosts the children's awareness, and this is passed on to the parents and the surrounding neighbourhood."

"A project would like this would normally cost 2 million euros. In the end, though, we paid 1.3 million. The 6,000 solar panels produce around 1.5 million kilowatt-hours of clean energy a year, around half our total annual electricity consumption, and a massive saving on our energy bill of about 150,000 euros per year."

Joke: "You'd want this for every school and child. I have two tips for projects: first, ensure that the energy proceeds go to the school and not to a leasing company, so the money flows back into the education. Second, appoint a process supervisor from the municipality. Process supervisors can get things done that a school board would never be able to do." In the meantime, an even larger project has been launched, in which six school boards are planning to install solar panels on the roofs of fifty schools.

Cumbersome or opaque procedures, not rules, are often the problem. This applies at all levels, but especially to the municipality's own procedures. We have already taken steps, including an adapted planning memo (*welstandsnota*) and monuments framework (*monumentenkader*) with more options for solar panels, a municipal rights approach to installing solar panels, and a zero-rate permit fee for sustainable renovations and emissions-free removals vans.

We will set up a help-desk where citizens can report obstructive rules

Approach

A sustainable city requires new, shared solutions and partnerships that grow out of the signals we receive from citizens. We are working with various partners, including central government, the provincial authorities, the Metropolitan Region Amsterdam and the Regional Agency for the Environment. When we can solve problems ourselves, we do.

Wherever possible, for example, we are simplifying, adjusting or even abolishing unnecessary or obstructive rules in Amsterdam that hinder sustainability measures. We provide tailormade solutions wherever necessary and feasible.

When we encounter obstructive regulations that we cannot tackle ourselves, we raise this with central government. The system of legislation and regulations is constantly changing, and it is split across different ministries. Moreover, laws and regulations are running to catch up with innovations. Obstacles can arise in practice when innovative technologies are developed that do not (yet) fit within the legal framework, and there is a need for space for experimentation. Amsterdam is actively lobbying for regulations and preconditions that support the acceleration of the energy transition.

We are streamlining internal procedures and processes that have an obstructive effect. In 2020, we will roll out the 'Green carpet', making it simpler to install solar panels on monuments and in conservation areas. With the responsible departments, we are focusing on clear procedures and ensuring that all citizens can go to a single help-desk for questions and solutions. We are also helping residents to get permits, we share our practical experience with exemplary projects, and we are working towards standardised procedures and designs. In this way, we are improving our procedures, rules and communication. This approach can be broadened to cover other themes in future.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Jutta van Ballegooijen

Partnership Manager at Plastic Whale

"Both at home and in my work at Plastic Whale, I'm very involved in sustainability issues. When I go shopping with my children, we always pick up plastic in the street on the way. That's because my children, like me, can't bear seeing litter in the street anymore."

"Next year, we want to renovate our house as sustainably as possible. Preferably with solar panels, but also with a green or sedum roof. I don't know if it's possible to have both at the same time, but I think a way should be found to combine the two. We also want a heat pump, and we eventually want to disconnect from the gas grid. I hope we manage it, because costs are always an issue, too. At present, I'm trying to find out how we can best do all of this."

"Both at work and at home, I really want to inspire people to take action. I think that if everyone took action, we would not only be able to help make Amsterdam more sustainable, but also the whole world."

"In my work at Plastic Whale, we want to inspire as many people as possible to take action and contribute to our mission to rid water around the world of plastic. We do this by literally fishing plastic out of Amsterdam's canals, but also by holding workshops and lectures. We use the plastic we've collected to make furniture and boats."

Glossary

Amsterdam Climate Agreement

A combination of more than 200 initiatives: large and small, new and more established. It provides insight into the many local neighbourhood initiatives, as well as the plans of large companies and institutions, including the Port of Amsterdam, Waternet and Artis Zoo.

Amsterdam Climate and Energy Fund (*Amsterdams Klimaat- en Energiefonds, AKEF*)

The AKEF provides corporate financing in the form of risk-bearing investments and loans.

Aquifer thermal energy system

A sustainable local heating system based on surface water.

ATELIER

EU project in which thirty international partners cooperate to build energy-supplying districts in Buiksloterham in Amsterdam and Bilbao, and to scale up the lessons learned to other districts in Amsterdam and Europe.

BENG (*Bijna Energie Neutrale Gebouwen, 'Almost energy-neutral buildings'*)

From 2021, BENG will replace the EPC (energy performance coefficient) for new buildings. The three new legal requirements of BENG are:

- The energy needed for heating and cooling a home is no more than 25 kWh/m²/year (thermal energy.
- The primary (fossil) energy used by warm water and installations in a home is no more than 25 kWh/m²/year.
- The home's share of renewable energy is at least 50%. This is the percentage of energy, for example, from solar panels, a solar boiler, a heat pump and (under certain conditions) biomass, or a connection to a heat distribution grid.

Biofuels

'Biofuels' is a generic term for different kinds of fuels that are made from plant-based materials or waste, such as biodiesel, bio-ethanol and biogas.

Biomass

Plant- and animal-based residual that is used as a raw material for generating energy, or directly as a biofuel.

Carbon Capture, Storage and Utilisation (CCSU)

CCSU stands for Carbon Capture, Storage and Utilisation.

Carbon-neutral building

A carbon-neutral building produces as little CO_2 as possible, and compensates for any remaining carbon emissions with internal or external facilities.

Charging infrastructure

Charging network for electric transport.

Circular economy

The concept of the circular economy forms the foundation of the cradle-to-cradle principle. In a circular economy, all of the materials in a product are reused usefully, without this resulting in a loss of quality. When all residues can be re-used and products are environmentally neutral, the cycle is complete.

City Deal Amsterdam Natural Gas-Free

Specific cooperation agreements between cities, central government, other governmental authorities, companies and civil society organisations, focused on pilot projects and research on alternatives to the fossil-based heating system.

Climate adaptation

The process by which society (including the built environment) adapts to the current or expected climate and its effects. The harm that can accompany climate change is anticipated, and use is made of the opportunities offered by climate change.

Climate Budget

A climate budget is a management and governance instrument for meeting climate targets (in this case, the targets of the Municipality of Amsterdam). Amsterdam's Climate Budget is not limited to the municipal organisation's emissions, but covers all municipal actions that contribute to the reduction targets. The Climate Budget also includes measures by the municipality that do not lead directly to reduction, but that are needed for the transition.

Climate Fund

The Climate Fund is an important municipal financial instrument. The Mayor and Cabinet have deposited a total of 150 million euros in the Climate Fund to support the energy transition in Amsterdam.

Climate Law

The Netherlands has its own Climate Law. This law provides that we must reduce our carbon emissions by 49 percent in 2030, and by 95 percent in 2050, compared to 1990. The share of sustainable energy will simultaneously rise to 100% by 2050.

Climate-neutral

Climate-neutral can be achieved by radically cutting carbon emissions and compensating for the remaining emissions.

Climate Neutral Roadmap 2050

Ambition document that describes how the city of Amsterdam is working together to achieve a climate-neutral city, and the role that the municipality is playing in this.

CO_2

Carbon dioxide, a greenhouse gas. The use of fossil fuels such as oil, gas and coal results in a rise in the amount of CO_2 in the atmosphere. In nature, CO_2 is a building block.

CO_2 compensation

Compensating for the greenhouse gas emissions associated with an organisation, manufacturing process or consumption. Environmentally, it does not matter where the CO_2 is emitted or where it is removed from the atmosphere. Sometimes, it is not (yet) possible for a certain company to cut its carbon emissions. In such cases, it is possible to prevent an equal quantity of CO_2 being emitted elsewhere or to capture the same quantity in the environment.

Code of conduct on the acceptance of and participation in onshore wind energy (*Gedragscode Acceptatie & Participatie Windenergie op Land)*

The core principle of the code of conduct is that parties in the surroundings should be involved in wind projects at the earliest possible stage. The code of conduct is signed by Greenpeace, Milieudefensie, NWEA, Natuur & Milieu, Natuur-en Milieufederaties and ODE Decentraal.

Convention on Climate Change

In 1992, Framework Convention on Climate Change was agreed by the UN in Rio de Janeiro. The aim was to stabilise the concentration of greenhouse gases in the atmosphere at such a level that a dangerous human impact on the climate could be prevented. In the mid-1990s, it became clear that stabilisation of greenhouse gas emissions would not be sufficient to achieve the ultimate goal of the Convention. This led to the Kyoto Protocol (1997) and the Paris Agreement (2015).

District heating

A heating system in which homes are heated by means of an underground network of hot water pipes. There are two large hot water networks in operation in Amsterdam, with a total of 84,700 connections (2017).

Doughnut economy

The doughnut economy is an economic model that measures economic prosperity by looking at whether a social foundation is achieved without overshooting an ecological ceiling. The objective is for everyone's needs to be met within the earth's capacity. The term 'doughnut' is derived from the shape of the diagram: a circle with a hole in the middle. The hole in the model represents how many people have no access to basic necessities, such as healthcare, education and accommodation. The crust represents the extent to which the ecological ceiling (planetary limits), on which life is dependent, is being exceeded. According to the model, an economy is prosperous if the twelve elements of the social foundation are in place without overshooting the ecological ceiling. The model describes this situation as the 'safe and just space for humanity'. The model was developed by the Oxford-based economist Kate Raworth.

Emissions Trading System (ETS)

An emissions trading system (ETS) is a market mechanism whereby the actors (such as countries, companies or factories) that emit greenhouse gases into the atmosphere can buy and sell emissions (in the form of licenses or allowances). The European Union's emissions trading system (EU ETS) assumes that the creation of a price for carbon is the most cost-effective way to achieve the considerable reductions in global greenhouse gas emissions that are needed to prevent climate change from reaching dangerous levels.

Energie Beheer Nederland plc (EBN)

EBN is 100%-owned by the Dutch state and implements parts of the climate and energy policy of the Ministry of Economic Affairs and Climate Policy. Until 2016, EBN mainly focused on tracing, extracting and storing gas and oil. EBN now focuses on the energy

transition in the Netherlands. EBN has expertise in the Dutch substratum and brings together private and public parties in the energy sector.

Energy cooperative

A cooperative that focuses on promoting a sustainable energy supply. A number of regional and national energy cooperatives are active in the Netherlands. The number of participants can vary from several dozen to thousands.

Energy label

An energy label shows a building's energy consumption class. It is the short name for the 'energy performance certificate for homes and buildings.' In 2002, the European Parliament adopted the Energy Performance of Buildings Directive (EPBD guideline). This focuses on reducing buildings' energy consumption, with a view to cutting carbon emissions and reducing dependence on fossil fuels.

Energy-neutral

A situation in which the energy consumption of a built object (home, building, district, artwork, etc.) is measured as at least zero over a period of one year: i.e., the built object does not take more energy from the gas and electricity grid than is supplied from renewable sources.

Energy-neutral according to the Association of Netherlands Municipalities (definition for private individuals)

A home is described as 'energy-neutral' when in, on top of, on or close to the home, as much renewable energy is generated each year as is used for all forms of energy consumption in and around the home.

Energy performance coefficient (EPC)

The energy performance coefficient (EPC) is an index that lists the energy efficiency of newbuilds, determined by the calculations established in norm NEN 7120. On 1 January 2020, the EPC was replaced by the BENG standard.

Energy poverty

When more than 10% of a household's net income is spent on energy consumption costs.

Energy transition

The transition from a fossil-based to a renewable energy supply by 2050 in the Netherlands. By 2050, energy will be clean, affordable for all, and supplied continuously.

Environmental Plan (*Omgevingsplan*)

The Environmental Plan contains all of the rules set by the municipality in relation to the physical environment. Every municipality has an environmental plan.

Fossil fuel

Fossil fuels are hydrocarbon compounds that developed from the remains of animal- and plant-based life in the earth's geological past. Examples of fossil fuels include oil, natural gas, coal and lignite.

Geothermal energy

Geothermal energy makes use of the earth's heat (geothermal heat), created in the core of the earth by natural radioactive decay. This can be used to heat homes, utility buildings or greenhouses, as well as for electricity generation. Between a depth of 1 and 4 kilometres, the temperature rises from 40 to 130 °C, which is why we refer to 'deep' geothermal energy. Extracting this deep thermal heat only requires energy to pump water; the cooled water is carried back into the ground.

Greenhouse gas

The most important greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and the fluorine compounds HFK, PFK and SF_6.

Greenhouse Gas Protocol

The Greenhouse Gas Protocol (GHG Protocol) was launched in 1998 with the dual objective of developing an international standard for accounting and reporting on the emission of greenhouse gases by companies, and distributing this standard as widely as possible. The Greenhouse Gas Protocol distinguishes between different 'scopes', based on the origin of the greenhouse gas.

Green hydrogen

Green hydrogen is hydrogen from a renewable source that is produced using renewable energy. The two primary sources of green hydrogen are water (extraction using sustainable electrolysis) and biomass.

Groennet

An attractive and peaceful network of cycling routes.

Greenhouse effect

The term 'greenhouse effect' is often used in everyday speech to refer to the strengthened greenhouse effect resulting from an increased concentration of greenhouse gases in the atmosphere. This leads to a rise in the

average temperature on earth and climate change. The Intergovernmental Panel on Climate Change, the UN's climate panel, has concluded that the burning of fossil fuels by human activity is the most important cause of increased concentrations of greenhouse gases. The greenhouse effect is the natural phenomenon whereby certain gases in the atmosphere inhibit the radiation of heat from the earth. Greenhouse gases are essential for life on earth, but high concentrations can cause serious changes to the climate that threaten that same life on earth.

Ground-coupled heat exchanger

The storage of cold or heat for the purpose of cooling or heating, respectively, for example (tap) water or a building.

Heat exchanger

See: Ground-coupled heat exchanger

Heat pump

A heat pump extracts heat from a source (such as groundwater), raises the temperature and transfers this higher temperature to a particular space. A heat pump can be combined effectively with low-temperature heating.

High-efficiency awning

Automatically-operated awning that regulates the radiation intensity on a facade and considerably improves the degree of thermal comfort. A high-efficiency awning can deliver a 10% saving on a building's energy performance coefficient (EPC).

High-efficiency glazing

High-efficiency glazing has a U-value of 1.6 W/m^2 K (HR+ glazing) and 1.2 W/m^2 K (HR++ glazing). High-efficiency glazing consists of two or even three frames with a cavity and coating in between, and has a much higher insulation value than 'normal' double glazing.

High-efficiency ventilation

High-efficiency ventilation is a mechanical ventilation system whereby fresh outdoor air is pre-heated by extracted interior air.

House of Skills

The House of Skills is a public-private partnership in the Metropolitan Region Amsterdam (MRA), in which companies, sector organisations, employees' and employers' organisations, research institutes, educational institutions and administrators from the region work together closely to transform today's labour market into a more skills-oriented labour market.

Human Capital Agenda on the Climate

A Human Capital Agenda contains a vision, ambition and approach for achieving effective linkage between educational institutions and the labour market. The aim is to tailor education more effectively to the labour market and further develop current personnel. On 18 October 2019, the MRA authorities, the business community and educational institutes agreed to work on ensuring an adequate workforce for the climate challenge.

Institute for Sustainable Process Technology (ISPT)

The ISPT is a partnership between industry, universities and research institutes that focuses on accelerating innovation processes and making them more efficient, by developing knowledge and demonstrating and applying pioneering technology. The ISPT has a special focus on process technology.

Kyoto Protocol

The Kyoto Protocol was drawn up in 1997 to supplement the Convention on Climate Change. In the Kyoto Protocol, industrial countries committed to reducing emissions of greenhouse gases in 2008-2012 by an average of 5%, compared to the level in 1990.

Launching customer

A launching customer is the first client to use a product. They are also prepared, for example, to act as a referee on a demonstration site in order to help convince new clients.

Liander

Dutch utilities company that manages the medium- and low-voltage electricity grid and the high- and low-pressure gas grid in part of the Netherlands. Liander plc manages the energy network in the provinces of Gelderland and Noord-Holland, and in large parts of Flevoland, Friesland and Zuid-Holland.

Mobility as a Service (MaaS)

Digital mobility concept, whereby the consumer uses different forms of transport via a single subscription. This means that there is no need to worry about needing to make reservations or payments, and any interim adjustments (e.g., in the case of cancelled public

transport or traffic jams) are handled automatically.

National Climate Agreement

The Dutch implementation of the Paris Climate Agreement. Signed in June 2019, it contains more than 600 agreements between companies, civil society organisations and governmental authorities to collectively halve emissions of greenhouse gases in the Netherlands by 2030 (compared to 1990). The Dutch Climate Agreement is an agreement between multiple organisations and businesses in the Netherlands to combat global warming.

Natural gas-free

Not connected to natural gas, a fossil fuel. This does not mean 'gas-free'; green gas can be used, for example.

Netherlands Wind Energy Association

The Netherlands Wind Energy Association (NWEA) is the sector organisation of the Dutch wind industry. The NWEA promotes the development of wind power with a view to sustainable energy provision in the Netherlands. On behalf of and in partnership with its members, the NWEA works to achieve a strong wind sector and the new policies that this requires.

New Amsterdam Climate

Online and offline platform for Amsterdam's climate movement.

North Sea Canal Area

The North Sea Canal Area administrative platform covers the seaports of IJmuiden, Beverwijk, Zaanstad and Amsterdam, the municipalities and the Province of Noord-Holland.

Owner-occupiers' association

An owner-occupiers' association (*Vereniging van Eigenaars, VvE)* is the overarching body that all owners automatically (legally) join as soon as they purchase joint ownership in a building. The VvE is responsible for the maintenance and management of the building, and ensures money is saved for large maintenance projects. The VvE is also responsible for insuring the building.

Paris Agreement

The Paris Agreement forms part of the Convention on Climate Change, an international treaty that was agreed in order to curb global warming. The agreement was presented at the Paris climate conference on 12 December 2015. For the first time, the agreement set a legal upper limit of 2 degrees of warming compared to the pre-industrial era. Moreover, the agreement established the aim of limiting global warming to 1.5 °C. Furthermore, the agreement states signatories must soon phase out fossil fuels, as this is an important cause of excessive carbon emissions. The treaty requires member states to draft increasingly ambitious national climate plans. In addition, the agreement establishes that rich countries are expected to provide financial assistance to help developing countries to reduce their emissions. From 2023, there will be a global evaluation (Global Stocktake) of the emissions (reduction) every five years.

Port of Amsterdam

The Port of Amsterdam plc is responsible for the management, operation and development of Amsterdam's harbour. Since 1 April 2013, the Port of Amsterdam has been a private company, with the Municipality of Amsterdam as its sole shareholder. The Port of Amsterdam manages over 1,900 hectares of harbour area, including harbour sites, loading and unloading docks, roads, railways and 600 hectares of waterways. It is known internationally as the Port of Amsterdam.

Postcoderoos-regeling

The *postcoderoos-regeling* or 'lowered rate regulation' is a measure that allows private individuals to generate sustainable energy in their neighbourhoods. The energy that is generated is sold to an energy company, so that the same financial yield can be obtained per kWh as if the solar panels were on their own roofs.

Regional energy help-desk (*Regionaal Energieloket*)

The regional energy help-desk (Regionaal Energieloket) advises and supports residents who want to green their homes, providing advice, house scans and offers for specific measures.

Regional Energy Strategies (RESs)

The national agreements in the National Climate Agreement are developed in 30 Regional Energy Strategies. Every region investigates demand for heat and electricity, and states how much sustainable heat and electricity can be generated in its territory. All of the regional strategies are brought together at the national level.

Regional heat strategy (*Regionale Structuur Warmte, RSW*)

The part of the Regional Energy Strategy that concerns heat is known as the *Regionale Structuur Warmte* (RSW). The RSW charts the demand for and supply of heat, and the heating infrastructure.

Renewable energy

Clean, renewable and non-depletable energy that does not harm the environment. Examples include wind energy, solar energy, hydropower and geothermal energy (extraction of heat from the earth).

Scope 1 emissions

Scope 1 emissions are direct CO_2 emissions within Amsterdam's municipal borders, such as a factory's emissions, the combustion of natural gas in a gas boiler or the combustion of petrol in a car.

Scope 2 emissions

Scope 2 emissions, or indirect emissions, are created when generating electricity and heat, and can be attributed to Amsterdam due to the consumption of electricity and heat in the city.

Scope 3 emissions

Scope 3 emissions, or other emissions outside Amsterdam, are caused during the production of the materials that we use or the food we eat.

Smart mobility

By developing a smarter transport system, we can reduce the number of polluting kilometres travelled in the city. This includes provisioning by combining goods orders, carshare schemes and mobility as a service, autonomous vehicles, etc.

Source book (*bronnenboek*)

Amsterdam's source book lists the sources that are available in Amsterdam for heating and cooling buildings, and which sources can be used now and in the future.

Spatial Vision

The state, provinces and local authorities each establish a spatial vision: a strategic long-term vision on the entire physical environment. The spatial vision relates to all territory in the surroundings. It addresses the relationship between space, water, the environment, nature, landscape, traffic and transport, infrastructure and cultural heritage.

Sustainable Development Goals (SDGs)

Seventeen interlinked global goals, established by the UN to bring an end to poverty, inequality and climate change.

Sustainable energy/heat sources

Sustainable energy is generated from sources that cannot be depleted. Fossil fuels such as oil, coal and gas can be depleted (run out). Non-depletable energy sources include solar energy, wind energy, hydrogen, geothermal energy, tidal currents and wave energy.

Sustainable energy subsidy (*Stimuleringsregeling Duurzame Energieproductie, SDE++*)

The SDE++ scheme is a national scheme to promote the production of clean and sustainable energy.

TenneT

TenneT is a Dutch-German transmission system operator that transports electricity and manages the balance between the electricity supply and demand. TenneT manages the national high-voltage grid in the Netherlands. The Dutch state holds a 100% stake in TenneT in the Netherlands.

Transitievisie Warmte

The vision document on the heating transition, or *Transitievisie Warmte*, establishes the timeframe for phasing out natural gas and the most readily available alternative forms of heating. All existing real estate in a district is addressed: homes, commercial buildings, offices, restaurants, social and civic buildings such as schools, and other buildings.

Transition

A transition is a fundamental system change that affects the whole of society. According to the Council for the Environment and Infrastructure, at least three transitions are currently underway: the energy transition, the raw materials transition and the food transition. The first aims to reduce carbon emissions to zero in 2050, the second aims to create a circular economy, i.e., a no-waste economy, and the third aims for circular agriculture. The three transitions are also interlinked, which is why the Council refers to them as 'the sustainability transitions'.

Waste heat

Many industrial processes release waste heat, which often disappears

up a chimney or in cooling-water. This so-called 'waste heat' can be used elsewhere as an energy source.

Waste incineration plant (AVI)

A plant that is intended specifically for the incineration of waste.

Waste-to-Energy

Afval Energie Bedrijf Amsterdam (AEB Amsterdam) is a waste-to-energy company in Amsterdam. The company processes waste at two waste-incineration plants, whereby the heat that is released is used to generate energy.

WestPoort-Warmte

A joint venture between Nuon Warmte and AEB plc, which operates the western heat grid in Amsterdam.

Zero-emissions bus

Emissions-free public bus transport.

02025

Platform 02025 organises meetings, including the 'energy breakfasts' and technical consultations for frontrunners in Amsterdam who want to take sustainability measures in their neighbourhoods.

!WOON

!WOON advises and assists residents with sustainability measures at home. They deploy energy coaches and help owner-occupier associations to draw up sustainable multi-annual maintenance plans.

Colophon

New Amsterdam Climate
Amsterdam Climate Neutral Roadmap 2050
February 2020

Final version, following *Roadmap Step 1: An invitation to the city, January 2019*

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