


Prague Climate Plan 2030

Prague on the road
towards carbon neutrality

An aerial photograph of Prague, Czech Republic, taken during the golden hour of sunset. The city is densely packed with buildings, many with red-tiled roofs. The Vltava River flows through the center, with the Charles Bridge crossing it. The sky is a mix of blue and orange, with the sun low on the horizon. The overall scene is peaceful and scenic.

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The Prague Climate Plan Until 2030 was prepared under the direction of the Committee on Sustainable Energy and Climate, an advisory body to the Prague City Council. It outlines strategies for reducing CO₂ emissions produced as a result of the city's energy consumption by 45%. This document also acts as a Sustainable Energy and Climate Action Plan - SECAP, as defined by the joint initiative of European cities and towns acting under the name Covenant of Mayors for Climate & Energy, which the city had formally joined in 2018.

The Prague Climate Plan 2030 was approved by the Prague City Assembly by its Decision No. 27/30 of 27 May 2021.

I would like to express my gratitude to Tomáš Voříšek, Vojtěch Vosecký, Kateřina Schön, Jaroslav Mach, Daniel Vondrouš, Jaroslav Klusák, Tereza Líbová, and all members of the working groups and the Committee on Sustainable Energy and Climate who directly or indirectly contributed to this document.

- Martin Bursík, chairman of the Committee on Sustainable Energy and Climate



**Pražská mise
Nulové emise**



With support from:

Ministerstvo životního prostředí



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We thank all the organizations and institutions that provided photographs for the publication. These include Jakub Cigler Architekti, Nadace Partnerství (www.nadacepartnerstvi.cz) & Adaptterra Awards (www.adaptterraawards.cz), IPR Praha, DPP, PRE, a.s., National Theatre, Pražské služby, a.s., Kokoza, o.p.s. If the source of the photograph is not indicated, it is a photograph taken by the team of authors or sourced from the Capital City of Prague photo database.

PUBLISHED BY Prague City Hall, Environment Protection Department

ENGLISH TRANSLATION Lucie Lollková, MA, MSt

ILLUSTRATIONS Jakub Cigler Architekti

PRODUCTION & DESIGN AnFas, spol. s. r. o. (www.anfas.cz)

PUBLICATION DATE October 2021

COVER PHOTO CREDIT Daliu80 / Dreamstime.com



Printed on paper from responsible sources and using eco-friendly inks.

<https://klima.praha.eu> | klima@praha.eu

Table of Contents

Transforming Prague into a Climate Responsible City, foreword by Zdeňek Hřib [5](#)

Vision of a Climate Responsible Prague, foreword by Martin Bursík [7](#)

Executive Summary [10](#)

10 priority projects and their financing [16](#)

Summary of all 69 measures proposed in the four sections of the Prague Climate Plan [20](#)

Summary of benefits and costs of individual measures [30](#)

Overall benefits and costs of the Climate Plan [31](#)

Carbon Footprint [32](#)

Which CO₂ emissions are included and what is the reference baseline? [32](#)

Carbon budget until 2030 (with aims for 2050) [34](#)

Sustainable Energy and Buildings [36](#)

Core priorities

New renewable energy power plants [40](#)

Renewal of the current building stock to increase achieving modern 21st century metropolis standard [43](#)

New construction as an opportunity for short distances city and as direction via further carbon neutrality [49](#)

Reducing the carbon footprint of heat production [52](#)

Environmental accounting and the carbon budget [55](#)

List of proposed measures [56](#)

Sustainable Mobility [58](#)

Core priorities

Increasing the attractiveness, capacity, and effectiveness of public transport [62](#)

Increasing the attractiveness, capacity, and effectiveness of non-motorised transport [69](#)

Reducing the intensity of motor vehicle transport (especially in the central areas of the city) [73](#)

Exchanging conventional fuel vehicles for low and zero emission options [77](#)

Supporting the transformation of air transport towards sustainability [84](#)

List of proposed measures [86](#)

Circular Economy 88

Core priorities

Effectively preventing the production of household waste and waste across sectors 92

Sorting, recycling, and reusing the maximum percentage of waste 95

Effectively recycling and reusing sorted secondary raw materials 98

Introducing principles of the circular economy into the building and demolition sector 100

Cooperating with ministries and other sections of government administration, industry, experts, and the public 102

List of proposed measures 102

Adaptation Measures 104

Core priorities

Improving microclimatic conditions 109

Lessening the impact of extreme hydrological events 113

Adaptation of buildings and the environment 115

Increasing preparedness in climate-crisis management 123

List of proposed measures: 126

Implementation and Monitoring 128

Establishing a coordinator/managing entity 128

Introducing a system of energy management 128

Establishing a climate fund for the city 129

New regulations for procurement of products and services 129

Utilising external sources of financing 130

Continuous monitoring of outcomes 130

International climate partnerships for sharing examples of good practice 130

Financing the Plan 132

Priority measures (economically viable) 132

Other measures 133

Financial plan for the implementation of the Climate Plan 133

References 134

Appendix 1: Financial Support Tools 136

Appendix 2: Individual Sheets for the Measures of the Climate Plan Leading to a Significant Decrease in CO₂ Emissions 141

Transforming Prague into a Climate Responsible City

foreword by Zdeněk Hřib

Dear readers,

You are currently delving into the Prague Climate Plan 2030, the aim of which is to turn Prague into a city that is sustainable and responsible towards the environment as well as its inhabitants.

Our goal is to reduce CO₂ emissions by 45 % compared to 2010 levels by 2030 and achieve carbon neutrality by 2050 at the latest. We want to proceed in accordance with the Paris Agreement on climate change and the Intergovernmental Panel on Climate Change Special Report on Global Warming of 1.5 °C.

The Climate Plan therefore sets forth a set of concrete measures in four basic areas (sustainable energy, sustainable mobility, circular economy and adaptation), which are moreover being gradually expanded based on the latest findings.

We were already aware of the need to develop sustainable energy and energy self-sufficiency in Prague, but the world events, which considerably affected our lives as well, further reinforced this need.

I am therefore proud of the fact that, ever since it was published in 2021, the Climate Plan has been offering measures whose implementation will not only lead to cleaner air for Prague's residents, but also save them money.

Wishing you an inspiring read and the greenest possible future,

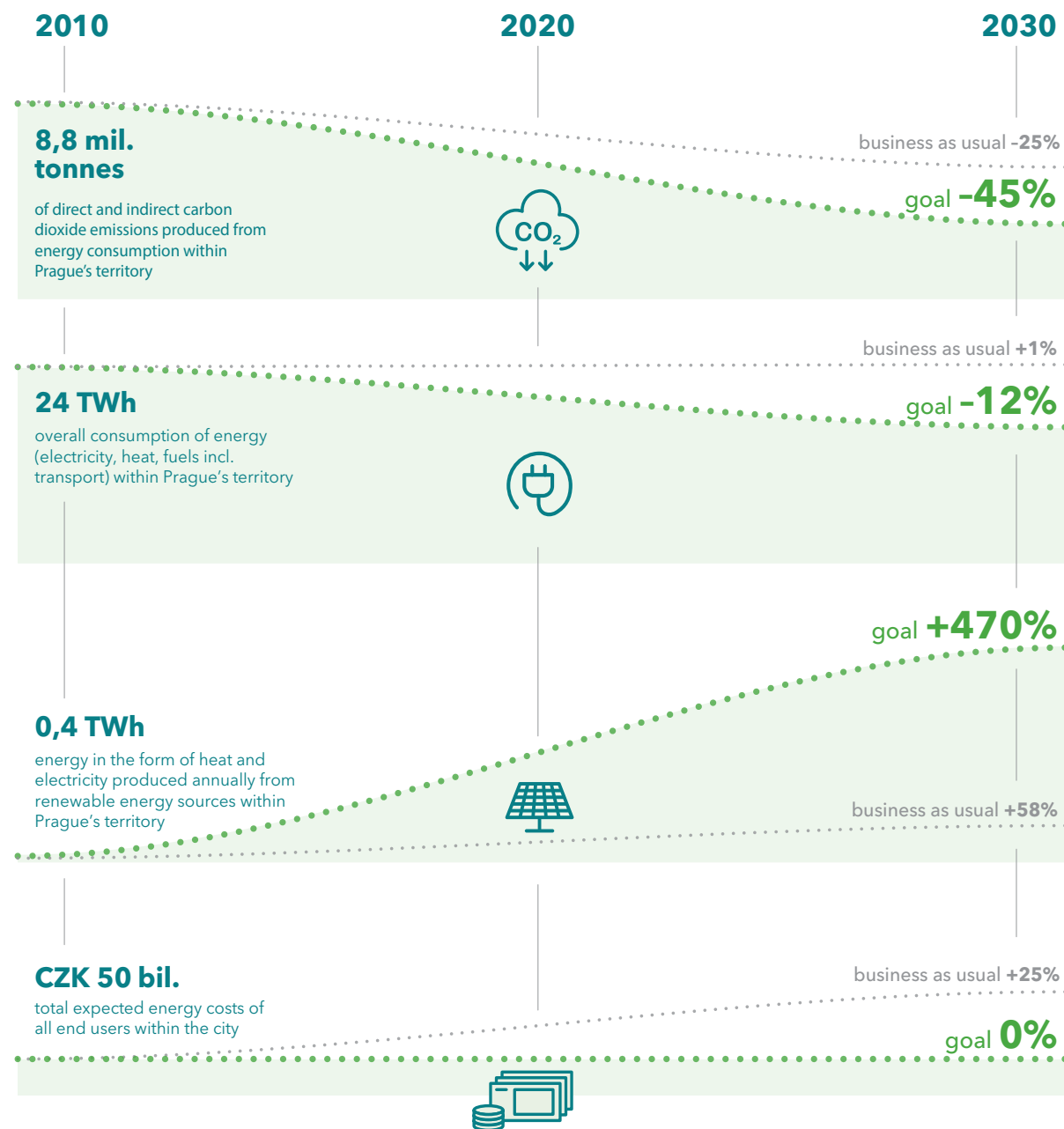
MUDr. Zdeněk Hřib

Mayor of Prague



FIGURE 1 **How the implementation of the Prague Climate Plan 2030 will be reflected in the reduction of CO₂ emissions**

The reference year (baseline) for the majority of indicators is 2010. For adaptation, the reference year is 2019. The target year for all measures is 2030.



Vision of a Climate Responsible Prague

foreword by Martin Bursík

„If the future is already here, just not very evenly distributed, find its germs, explore them and ask what our world will look like when these germs become reality. What the world will look like if these trends do not stop.“

Tim O'Reilly in WTF?: What's the Future and Why It's Up to Us

Let us imagine what life in Prague will look like in ten years. How will the city and its governance change? How can we come together to make Prague an ecologically attractive and climate-responsible metropolis? What new and innovative technologies can help us reduce our carbon footprint and CO₂ emissions? How will our lifestyle change? While a decade cannot be expected to bring about miracles, it can be the beginning of new positive trajectories for the city's life and management which steer it towards sustainable and climate-responsible development, and aid in its departure from a dependency on fossil fuels and CO₂ emissions.

Are we able to visualise hundreds (and later thousands) of roofs, façades, balconies, noise reduction barriers along roads, and small spaces populated with decentralised power plants? Your local micro-generator and energy savings are monitored on your smartphone, and you can watch the reduction in your own carbon footprint (or CO₂ savings). Surplus energy is then bought from you for a competitive price by the **Prague Renewable Energy Community** (or the Prague Energy Community), of which you are also a member. They will then offer electricity to someone who needs it within the community. The Community will offer to offset the energy you produce with a supply of green electricity sourced from newly installed renewable sources. Roofs of schools, retirement homes, theatres, cinemas, administrative build-

ings, family homes and apartment buildings - all these small energy sources connected in a system managing their surplus output.

Heritage management is respected because only those power plants whose visual surface does not interfere with the nature of the Prague heritage reservation are used (first as patterned foil but later true imitation "monk and nun" or "beaver tail" tiles). Those who do not directly own a roof or cannot come to an agreement with their neighbours may buy a share in an installation project of a photovoltaic plant elsewhere, which will provide them not only with a good conscience but also with cheaper electricity and stable dividends. We may imagine public buildings which use considerably less energy and possess higher quality indoor conditions, utilise rainwater runoff, and do not overheat during hot summers.

Or we can imagine that 3/4 of diesel-powered buses of the Prague Public Transit Company fleet are replaced with **buses equipped with electric and hybrid engines or (perhaps later) are hydrogen powered**. A system of dynamic toll gates is motivating drivers through economic incentives (rather than restrictions or by demanding compliance) to use public and other forms of shared transport. Bikes and transport on foot are becoming more prominent not only as a form of healthy lifestyle choices but also as standard modes of transport within the city. But there

are also other technologies which we cannot yet even imagine (not only the electric unicycle of Tomáš Sedláček). The roads will become less congested, while public transport will increase in speed, effectiveness, and competitiveness.

Let us imagine that **sharing electric and driverless cars** will become the new standard and that smart apps operating on the concept of “mobility as a service” will combine eco-friendly modes of transport to get you from place A to place B not only quickly but also effectively. Maintenance works on the streets of Prague will regularly include **optimisation of walkways and the establishment of bicycle lane infrastructure**. The share of pedestrian zones will rise, as will the capacities of **Park & Ride car parks** for those commuting or travelling into the city.

The Moldau river is full of **electric boats**, their use shifted away from being a tourist attraction to **a standard feature of the public transport network**. Next to them, we see boats transporting construction waste to be recycled.

Biodegradable waste (which makes up about half of all of general household waste) is collected from every household and retailer to be converted into advanced biofuels - **biomethane** - in new **biogas plants**. It is then used to power the new fleet of lorries of Prague Services. The circle is closing, and teachers can educate children about the **circular economy** using demonstrable examples.

Prague is now able to better **separate plastic waste** and **has found the end point for its utili-**

sation while simultaneously supporting zero waste packaging.

Let us imagine that we can make use of the **heat generated from wastewater treatment plants** to provide heating or air conditioning for a number of city districts through a series of smart heat pumps.

Let us also imagine that the people who are responsible for the individual steps in this process keep their minds and doors open for climate experts from progressive European cities, consult with them, and mutually share not only experience but also examples of good practice.

Finally, the **vision of a climate-responsible Prague** is fulfilled not only by the city administration but also on a voluntary basis through involvement of **smaller or larger corporations and companies, as well as by forward thinking residents themselves**.

This is exactly what we strive for. But there are many aspects which, as we are now, are constrained by decades of fossilised thinking and practices which we cannot even fathom.

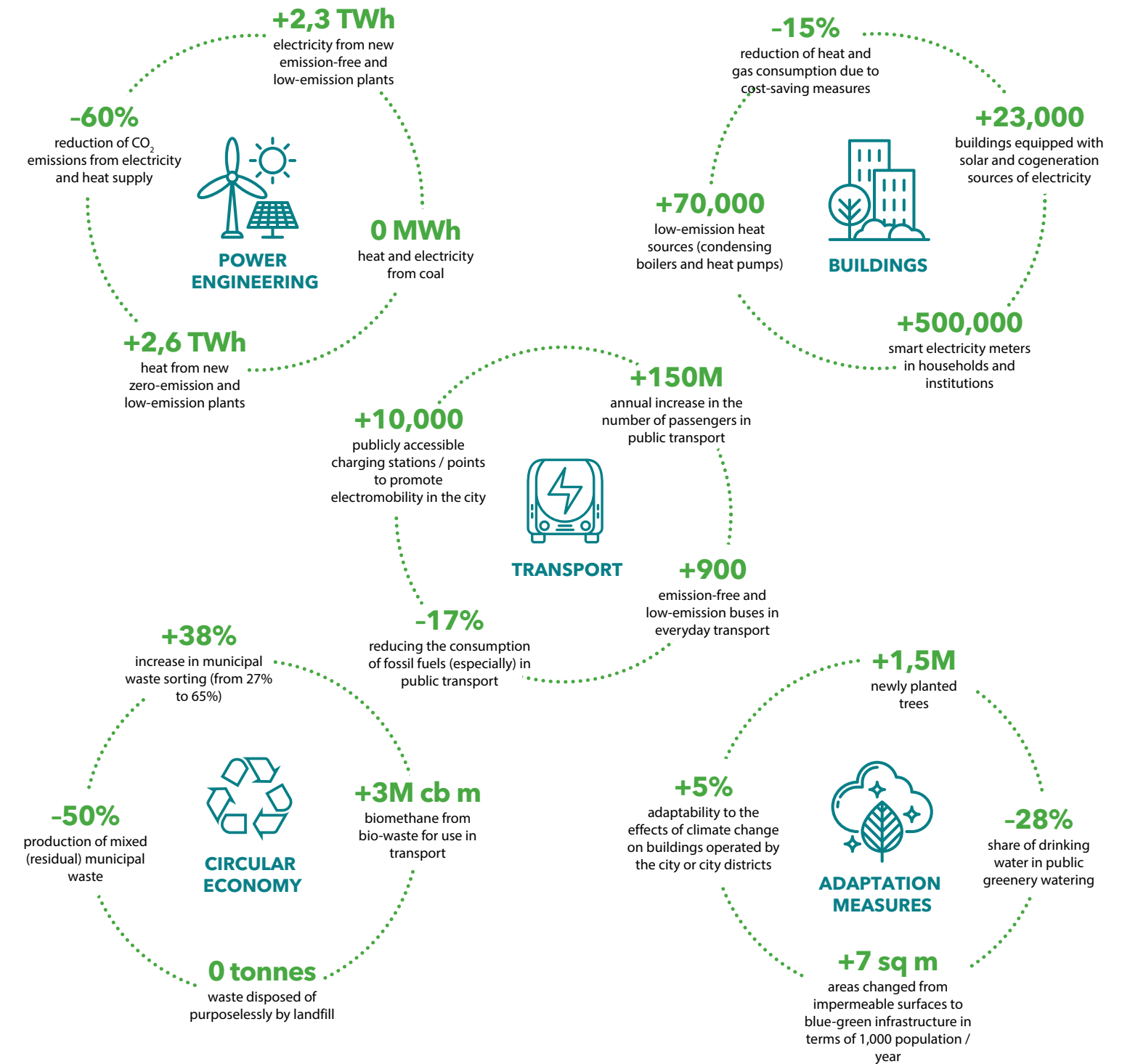
If we succeed in creating and defending our creative environment, and we come to an agreement on the baseline support for Prague’s climate efforts, new ideas are surely to emerge.



Martin Bursík
chairman of the Committee on Sustainable Energy and Climate

FIGURE 2 **Main changes brought to the city by the Climate Plan by 2030**

The reference year (baseline) for the majority of indicators is 2010. For adaptation, the reference year is 2019. The target year for all measures is 2030.



Executive Summary

In 2019, the Capital City of Prague accepted a breakthrough decision¹, through which it voluntarily declared to actively monitor and slowly reduce its direct and indirect carbon dioxide (CO₂) emissions. The city therefore officially **announced its climate pledge to a 45% CO₂ emission reduction by 2030** and also confirmed that it sees the departure from fossil fuel use in energy production, transport, and other economic activities as an opportunity, rather than a threat, in **transforming the city into an eco-friendly metropolis and an attractive place to live.**

Placing climate protection among political priorities carries both national and European significance. As a result of this decision, Prague has joined other progressive cities which have already vowed to keep a similar commitment. These encompass **more than twenty other world cities**, such as Amsterdam, London, Copenhagen, Helsinki, Stockholm, New York, and Washington, D.C.² This is a testament to the commitment of cities worldwide to solving the same issues, as they will be impacted in a multiplicity of ways by climate change - be it unbearable temperatures in the summer, drought, natural catastrophes, or rising sea levels.

The Prague Climate Plan (henceforth **"Climate Plan"**) reacts to the above-mentioned issues and presents options of how to fulfil the climate pledge primarily through energy savings and by utilising renewable sources of energy across main sectors and fields.

The largest potential for reducing CO₂ emissions lies in **replacing energy sources which the city uses to cover its use of electricity**. With the help of newly constructed solar, water, zero- and low-emission power plants (using cogeneration and natural gas), it is possible to ensure that Prague can be fully powered without the use of coal by 2030 (in comparison to

2010), which will allow for a reduction in CO₂ emissions **by approximately 2.5 mil. tonnes (22.5%)**. This is despite the projected increase in electricity consumption due to the expected development of electromobility and higher rate of electrification in heating and air conditioning.

The second main CO₂ emission reduction is expected to stem from decarbonisation of the **heat production and supply (district heating) sector**. Systems of heat supply within the city are able to undergo further integration with the aim to prioritise renewable heat and heat generated from secondary sources. Heat generated from coal burning would therefore be substituted with a combination of higher levels of waste incineration, innovative involvement of low-potential energy from wastewater through heat pumps, and the introduction of highly effective cogeneration units generating heat and electricity while utilising natural gas as a resource. These sources also have the potential to lower heat loss during distribution. The resulting effect would be a reduction of CO₂ emissions (due to future lower heat distribution needs as a result of reduction in end demands of consumption) **by more than 0.5 mil. tonnes annually**.

The third major source of CO₂ savings are **buildings**. There are more than 130,000 buildings where,

¹ Decision No. 8/42 of the Prague City Assembly from 20 June 2019 on announcing the climate pledge of the Capital City of Prague. [1]

² Carbon Neutral Cities Alliance (CNCA) - international alliance of cities which have made a pledge towards climate neutrality (www: <https://carbonneutralcities.org/>) [2]

for the overwhelming majority, measures for improving energy performance related primarily to reducing heat use (bought from external sources) and fuels used to cover their energy requirements, are yet to be implemented. The Climate Plan anticipates an overall reduction in the consumption of energy in this sector (including industrial buildings) almost by **10%**, which would correspond to a reduction in the carbon footprint by about **0.5 mil. tonnes annually**. CO₂ emission savings as a result of the introduction of local electricity sources can increase this value by another **0.4 mil. tonnes**. However, for methodological reasons, this number is included within the positives of changes in the energy mix in production and use of electricity.

The Climate Plan's ambition for the remaining portion of emission reduction lies in the **transport sector**. Through a combination of measures targeting a gradual substitution of cars using conventional fuels with electric cars and alternative fuels (particularly biomethane) and through a support programme for the development of public and alternative transport, it is possible to save **up to another 0.5 mil. tonnes of CO₂ annually**. One of the most important measures in the transport sector is the construction of new tramway lines.

The **circular economy** sector also brings about direct CO₂ savings by a partial substitution of fossil fuels in transport with biogas (biomethane). This will be supplied by a biogas station, currently under construction, which will utilise biological waste produced by households and restaurants. As a result, a large-scale separation of such waste within the city of Prague is intended for implementation in the foreseeable future. The biogas station also produces so-called "digestate" which is to be used as a fertiliser in agriculture. A portion of the biogas produced from wastewater treatment will be redirected to the transport sector. Finally, even leftover wastewater treatment sludges will be further utilised for energy purposes. Together with lower rates of waste production, reuse and recycling will create more CO₂ savings

to allow for further production of materials, resources, and products.

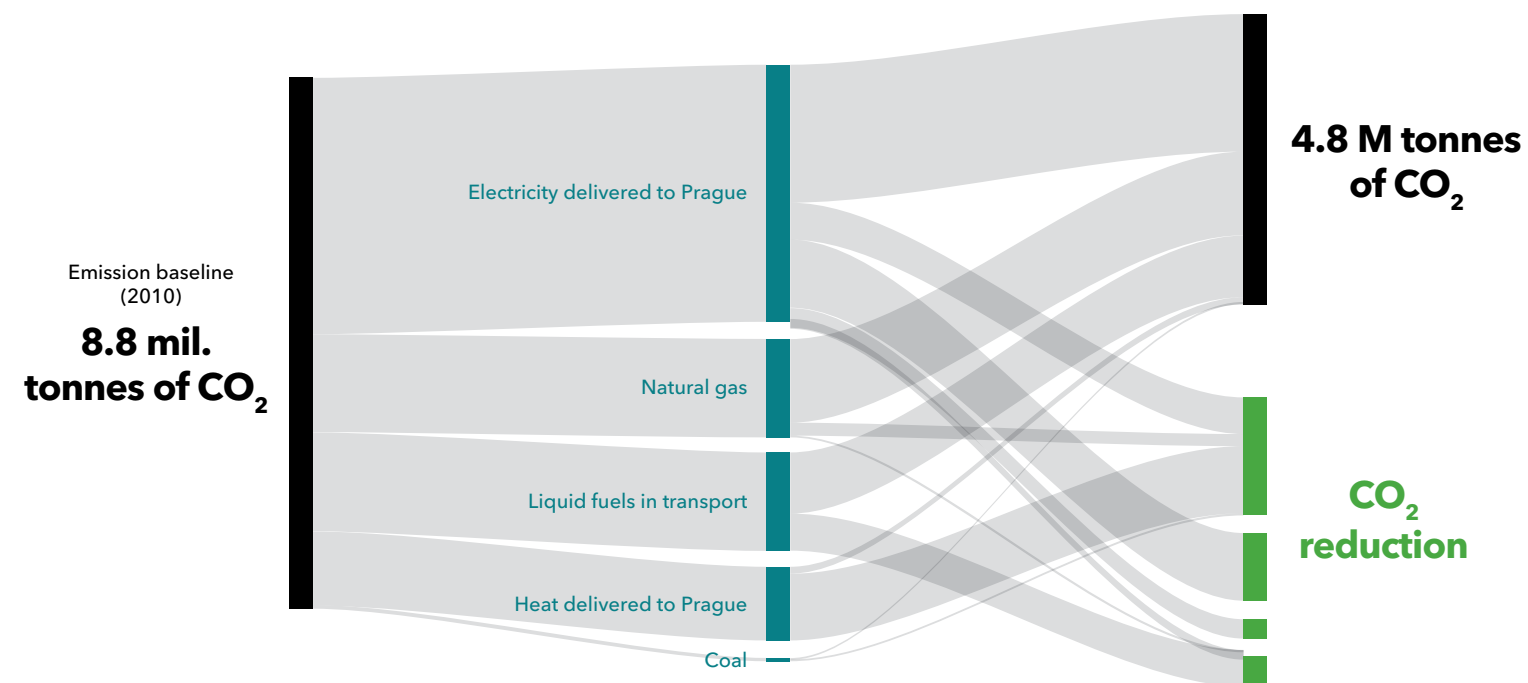
A clearly defined section of the Climate Plan focuses on the **adaptation of the city to the effects of climate change**. Currently planned measures of this type do not have a direct impact on lowering CO₂ emissions. They do, however, aim to improve the quality of life of Prague's residents amidst ongoing changes in climate. The most tangible results can be ensured by a higher ratio of trees in the city - **at least 1.5 million newly planted trees by 2030** - offering a multitude of benefits. Crucially, planting of trees in urbanised environments should be emphasized due to its essential role in eliminating the effects of the urban heat island. Prague shows a disproportionate amount of drinking water used for the purposes of public greenery maintenance (currently up to 83%). The current goal of adaptation projects is to lower these values to 55%, primarily by converting to utilising rainwater for watering through the construction of accumulation basins, or through setting systematised standards of rainwater management to ensure that maximum rainwater use is considered as early as in the building permit process. Other proposals are targeting public buildings owned by the city of Prague, where adaptation measures are still lacking. The target is to increase the number of adaptation measures within these buildings by 5%.

Extending the network of blue-green infrastructure is equally important for improving the quality of life of residents during extreme weather events. Development projects often lead to increases in urban density in areas with a good potential for blue-green infrastructure to remain. As a result, it is crucial to slow down this process and focus on increasing the conversion of impermeable or semi-permeable surfaces to blue-green infrastructure. This phenomenon is further supported by the current rise in urban density by 7 m² per 1,000 inhabitants per year.

Through this approach, introduced in more detail on the following pages, the Prague Climate Plan aims to reach overall savings in CO₂ of up to 45% of

FIGURE 3 **Changes in the CO₂ balance in Prague between 2010 and 2030 displayed as a Sankey diagram**

These are CO₂ emissions tied to the types of energy which are to be supplied within the city's territory (the reference year is 2010 and target is 2030).



its current carbon footprint, that is, around 4 million tonnes of CO₂.

The resources needed to reach this goal are divided between a number of activities, which will be put to action not only by the city itself, but also by households and various organisations.

These are, for the most part, investments which will bring about economic benefits from future energy savings. They will simultaneously improve the quality of life of residents and save time. If the planning, implementation, and financing of these strategies are managed correctly, it is highly likely that their returns will far exceed the initial financial resources invested in them.

The fulfilment of the Climate Plan goals will not only result in CO₂ reductions, but also holds great

potential for improving living conditions and the economic standing of the city, its inhabitants, and the institutions and companies which operate within it.

A key prerequisite for achieving this vision is the implementation of the Climate Plan as a whole, so that its individual measures are prepared and set in a wider context. On all decision making and planning levels, this approach strives to create a city which offers its inhabitants a polyfunctional living space, both horizontally and vertically, and which minimises the range of necessary movement by providing as many essential services as possible in one place, thus fundamentally altering the ecological impact of the city as a whole.

It is crucial to respect energy efficient building design that utilises renewable sources of energy and

types of transport which use “clean” energy for their operations. However, none of these will be sustainable in a city which does not support a good spatial and functional organisation and pushes its people to travel constantly and traverse long distances for necessities.

A city, in which we can find hundreds of passive energy buildings, or even active buildings, which are not embedded in polyfunctional, adequately populated areas, will not be sustainable by itself. However, a city of short distances and connections is – as can be clearly demonstrated by over a thousand years of Prague’s history up until the 20th century.

The main role of fulfilling the aims of the Climate Plan will be undertaken by the city of Prague and its elected representatives, institutions, and organisations which it either founded or shares ownership in.

The key steps on behalf of the city are the following:

- Introduce a good **system of energy management**, i.e., detailed overview of energy and resource spending which the city funds from its budget. The system should be developed in alignment with standard ČSN EN ISO 50 001 (and be certified accordingly) and over time include all sectors of energy usage on behalf of the city, city districts, and city organisations. Other than providing the opportunity to save on energy costs, this system may also be used during periodic monitoring to track the development of the carbon footprint produced by the city’s holdings, thus furthering the fulfilment of the climate pledge.
- Develop a **city climate fund** to accumulate (and increase the transparency of) resources which will be made available annually for the purposes of fulfilling the measures proposed in the Climate Plan.
- **Consider the carbon footprint in decisions regarding:**
 - Energy purchases (particularly heat and electricity),

- construction of new buildings or renewal of pre-existing buildings in city ownership,
- purchases of new vehicles or any services related to transport,
- selecting suppliers of other services (environmental standards).
- **Continuous co-financing of measures** explicitly proposed by the Climate Plan for which it will be possible to secure investments or other sources of external support (units in billion CZK/year).
- **Utilise the economic potential of energy savings and installation of renewable sources of energy in ownership of the city or city organisations** (with support of grants and the energy performance contracting (EPC) method).
- **Broaden the same principles to cover all city organisations, city districts, and involvement of the private sector.**
- **Establish an active role of the city in cogeneration** (enforce a development strategy aimed at ensuring affordable prices of heating while also lowering its carbon footprint).
- **Establish the “Prague Renewable Energy Community”** with the goal of accelerating the development of photovoltaics and their installation within the city, as well as smart monitoring.
- **Support sustainable mobility**, primarily in the form of pedestrian, bicycle, and multimodal transport, with the aim of reducing the collective carbon footprint of individual motor vehicle transport.
- **Ensure the city’s leading role in the development of electromobility** (charging infrastructure, cars, regulations for installing charging stations in indoor car parks, electrification of boats and river transport, etc.).
- **Secure external sources of funding and support** on the largest scale possible (ELENA programme, LIFE, Modernisation Fund, Innovation Fund, etc.).
- **Introduce technical support for organisations and inhabitants** aiming to enhance the preparation process and lower the financial strain of implementing measures leading to a reduction of

the city’s carbon footprint (e.g., by aiding in the completion of applications for subsidies and available grant programmes free of charge, etc.).

- **International cooperation** (climate partnerships with London, Copenhagen, Berlin, and other cities targeting mutual knowledge exchange, membership of the CNCA alliance, joint projects, etc.)

The Climate Plan is simultaneously aiming to cover the majority of initial expenditure through co-financing from national and European grants and subsidies available within the next ten years. Some of these programmes are:

- Modernisation Fund
- Innovation Fund
- Operational Programme Environment
- Integrated Regional Operational Programme 2
- Operational Programme Transport
- CEF - Connecting Europe Facility
- Recovery and Resilience Fund
- New Green Savings Programme
- ELENA
- LIFE

The above-listed programmes of financial support are estimated to provide in the dozens of billion Czech crowns (roughly estimated to be around 20 to 30 billion CZK) for the measures proposed by the Climate Plan during the period between 2021 and 2030.

Assuming the average rate of investment support at 30% of all expected expenses for the realisation of these measures, the resulting co-financing input on behalf of the city – here defined as not only the city

itself, but also including all other stakeholders – would be kept in singular units of billion CZK per annum in the 2021–2030 period. Another 1–2 billion would be made available for financing the initial expenses stemming from the Climate Plan’s specific measures through energy savings (and its lower purchase expenses).

Considering the current economic climate, the Climate Plan suggests focusing on those measures which can be financed from the above-listed support programmes in its first phase of implementation. This will also make them more economically viable from the investment standpoint (labelled as priority projects). These measures are described in further detail in the final section of the executive summary.

The Prague Climate Plan Until 2030 is divided into four main sections:

- Sustainable energy and buildings
- Sustainable mobility
- Circular economy
- Adaptation measures

Measures which have a positive (mitigation) effect on the fulfilment of the aims of the climate pledge of the city are proposed in the first two sections.

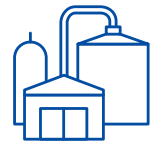
The remaining sections identify measures in greater detail than previously mentioned or propose reduction in CO₂ emissions in ways which are not possible to integrate into the current climate pledge of the city (greenhouse gasses resulting from the production of construction materials, food, and other items, etc.).

10 priority projects and their financing



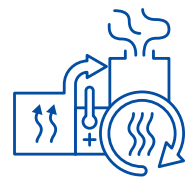
Introducing a system of energy management gradually for all buildings, establishments, and areas of use. Through this tool, the city will be able to evaluate the effects of energy saving solutions, develop further ones, and monitor the fulfilment of the Climate Plan.

The introduction of this system would be funded by a combination of resources from the Capital City of Prague, subsidy programmes co-financing the installation of monitoring devices capable of remote measuring (as part of complex projects focused on energy savings and installation of low and zero emission energy and heat sources), future savings on operating costs as a result of optimised use, and purchases of electricity, gas, and heat, as well as due to the general introduction of smart electrometers as supported by current legislation.



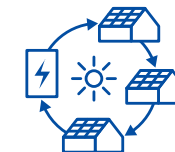
Constructing a biogas station aiming to utilise sorted and biodegradable waste for the manufacture of biomethane and its further use in the existing natural gas infrastructure to power the Prague Services (Pražské služby, a. s.) fleet.

The majority of investments involved in these measures can be sourced co-financed through OPE 2021–2027. Operational costs can then be partially supported through bonuses given for the biomethane produced; these conditions will make the station economically advantageous for the city (even when assuming that the investments not covered by subsidy programmes will be financed through a loan). Subsidy proposals are most likely to be accepted starting from 2022 or 2023 at the latest.



Utilising the low-temperature potential of waste heat from ÚČOV (Central Wastewater Treatment Plant) for heat generation supplying the heating infrastructure within the city area, as well as for innovative supply of the Bubny-Zátory development area with heating and cooling purposes.

A substantial portion (or even the majority) of starting investments can be co-financed from the Modernisation Fund and its programme No. 1 (HEAT) or potentially using the Innovation Fund set up by the European Commission. If securing one of these subsidies is successful, the plant will become economically advantageous for the city (even when assuming that the investments not covered by subsidy programmes will be financed through a loan). The programmes will open for proposals in 2021.



Founding the Prague Renewable Energy Community, including investments into installations of hundreds of MWp of power through PV integrated into buildings (roofs, façades, balconies, etc.) or located on current paved surfaces in the vicinity of buildings of whole areas in ownership of the city, as well as opening the Community to the public.

The majority of the initial investments for this measure can be co-financed through the Modernisation Fund and its programme No. 2 (RES+) – this would make installations of PVs economically advantageous for the city (even when assuming that the investments not covered by subsidy programmes will be financed through a loan). First proposals will be accepted in 2021 but the call will remain open for future years. Note: proposal for a pilot project was already submitted at the beginning of this year with the aim to secure subsidies from OPE 2014–2020 and its 146th open call for this project.



Realisation of complex energy savings in buildings of the public sector and infrastructure which are in ownership of the city. Main support will be directed towards the improvement of heat isolation properties of outer walls of buildings (through partial or complete insulation of walls and roofs, exchange or whole windows or their glazing and other features).

The majority of the initial investments for this measure can be co-financed from the Modernisation Fund and its programme No. 7 (Energy efficiency in public buildings and infrastructure) – securing the investment grant would allow for such savings-oriented projects to become economically advantageous for the city (as is possible to verify through the EPC method which will also cover the remaining expenses through future savings in operations). First proposals will be accepted in 2022 but calls will open again in the upcoming years. Note: first proposals for projects of this type were already submitted at the beginning of this year with the aim to secure subsidies from OPE 2014–2020 and its 146th open call.



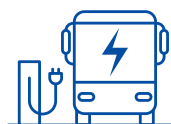
Modernisation of street lights and inclusion of public infrastructure of electric vehicle charging stations in new light systems. Retrofitting new public street lighting with more effective LED types, utilising smart regulation of light intensity.

The majority of initial investments for this measure can be co-financed from the Modernisation Fund and its programme No. 9 (Modernisation of street lighting infrastructure).



Automation of metro line C. New unmanned vehicles will allow for shorter intervals leading to a higher passenger transport capacity of the most frequented metro line. This will also allow for the use of the current vehicles serving this line to be transferred to the remaining two lines and modernising their fleet.

A possible source of partial funding for the initial investment is the programme OPT 2021-2027.



Substituting diesel-powered vehicles with electric buses or battery-powered trolley-buses. At least 75% of the current fleet of buses operated by the DPP HMP (Prague Public Transit Company) or contracted by ROPID from private transport companies will be substituted with zero emission vehicles (approx. 900).

A substantial part of initial investments for this measure can be co-financed from IROP 2021-2027 or through the Modernisation Fund the allowance for which is to be expanded. Another possible source of funding is the Renewal Fund (it is necessary to monitor its development and have projects ready to be submitted in case a co-financing opportunity arises).



Purchase low or zero emission lorries for the Prague Services fleet for the purposes of waste transport and sorted secondary waste, together with setting up charging stations. In the next 10 years, the PSAS (Prague Services) fleet will be renewed so that at least 75% of all used energy is substituted with bio-CNG produced by a biogas station utilising biodegradable general waste or electricity primarily sourced through cogeneration in the Malešice waste incineration plant.

A substantial portion of initial investments can be co-financed from the Modernisation Fund. Another possible source of funding is the Renewal Fund (it is necessary to monitor its development and have projects ready to be submitted in case a co-financing opportunity arises).



Construct new metro line D. Construction of a new metro line will expand the capacity of public transport and replace car and bus travel in the southern part of the city. The purpose behind the inclusion of this project in the Climate Plan is primarily to push forward its implementation. However, the investments and expenses necessary for its construction are not included in the financing part of the Plan due to their scope and difficulty in finding financing avenues.



The construction of a new metro line D is one of the most important Prague's transportation projects. The line will provide comfort connection for more than 150,000 inhabitants living in the southern part of the metropolis and will significantly increase the attractiveness of public transport. PHOTO: DPP



The modernisation of buses operated by the Prague Public Transit Company is aiming the ambitious goal of electrifying 75% of the vehicles. PHOTO: DPP



The PRE Group power company runs a pilot project of building a network of charging stations. PHOTO: PRE, A.S. / PAVEL LUX



Since 2008, the Prague Services company runs an initiative for reduction of local emissions. In 2018 it has started building its low and zero emission fleet, including the sweeping machines Bucher CityCat 220ev. PHOTO: PRAŽSKÉ SLUŽBY, A. S.

Summary of all 69 measures proposed in the four sections of the Prague Climate Plan (* marks priority projects)

Sustainable energy and buildings

- 1 Establishment of the Prague Renewable Energy Community***

The community will produce and supply energy from renewable sources. Its core will be formed around installations on public buildings and utilities, later expanding to other city districts and organisations in the city's ownership, as well as other institutions and residents.
- 2 Contact point for the city's residents**

Offering complex consultation services (partially financed from the Climate Fund) concerning house renovations for private residential buildings or apartments (e.g., One Stop Shop), as well as providing information about available financial grants and support from national grant programmes.
- 3 Installations of PVs on buildings or in their vicinity**

Utilising PSSE or other tools, the city aims to invest in the installation of hundreds of MWp of photovoltaic energy from buildings (roofs, balconies, etc.) or paved surfaces in or around areas owned by the City of Prague municipality.
- 4 Purchasing green electricity**

The necessary amounts produced from renewable sources will be bought to support individual production of green energy.
- 5 Modernisation of the distribution framework of electricity, heat, and gas**

The city, in collaboration with energy distributors, will support the establishment of smart measuring systems, the substitution of current transformers with new models with lower energy losses, renewals of substations and distribution boards, reduction of heat losses produced as a result of heat production and distribution of natural gas.
- 6 Energy management for the city's properties***

The city will gradually introduce a system of energy management within its buildings, facilities, and other areas of energy use, which will aid in evaluating the effects of energy saving measures, help to create others and monitor the fulfilment of the Climate Plan.
- 7 Implementation of complex energy savings in public sector buildings and in public infrastructure owned by the city***

Main support will be directed towards improvements in thermal properties of the outer faces of buildings (through partial or complete insulation of walls and roofs, change of windows or their glazing and other fills).
- 8 Complex and unified drafting of investment projects**

Preparation of projects fulfilling the requirements for innovative renovations coordinated by the city's energy manager. Stricter
- internal standards for economically viable projects will be gradually tightened for buildings in ownership of the city.
- 9 Complex EPC projects**

Utilising the Energy Performance Contracting method for different combinations of energy saving measures within a range of projects.
- 10 Modernisation of street lighting and incorporating public charging infrastructure for electric vehicles***

Retrofitting public lighting with higher efficiency LED utilising smart regulation of light intensity.
- 11 New construction offsetting carbon footprint realised by following the "city of short distances" mindset**

Construction of new buildings will be done in ways which take into consideration CO₂ emissions in the context of the entire life cycle of buildings, leading to their neutrality - first in the phase of use, later during construction and demolition of buildings; through an appropriately chosen placement and multifunctional construction methods, it will be possible to ensure that an increasing number of user journeys from/to work, school, or other services are realised through non-motorised (especially railway) public transport.
- 12 Reducing the carbon footprint of heat production**

the city will entirely replace its heat production using coal with secondary renewable sources by 2030. Heat generated from natural gas will still be partially used
- but only for so-called high efficiency cogeneration, together with simultaneous electricity production.
- 13 Utilising low temperature waste heat from ÚČOV Prague (priority project)**

A unique project which will utilise waste heat from the Central Wastewater Treatment Plant to supply heat networks within the city while also providing cooling to the new district of Bubny-Zátory.
- 14 Modernisation of heat exchange stations and management of the heating systems**

Modernisation of heat exchange stations will lead to a more effective management of the heat supply and its systems, further leading to a reduction in energy consumption.
- 15 Installation of a system of remote operated TRV valves on radiators**

This measure relies on the installation of a system allowing for remote control of thermostats (IRC systems).
- 16 Installation of heating and cooling sources utilising heat pumps**

Heat sources will be able to reuse waste heat to heat up water, resulting in gas or electricity savings. During the winter months they will work as an air-water heat pump up to temperatures of -5°C.
- 17 Installation of combined electricity and heat sources**

Natural gas cogeneration units - cogeneration units utilising natural gas for a combined production of heat and electricity will be installed in objects which

now use natural gas boilers as a heat source. A more efficient use of gas will further contribute to emission reductions.

18 Installation of power ventilation - recovery

Powered ventilation with recovery systems will be installed in 5,000 classrooms, in the first instance, designed as central, or possibly decentralised, systems. Energy efficient ventilation will ensure that hygiene standards are met.

19 Replacing coal powered boilers with natural gas and heat pumps

The city will support a modernisation of approximately 5,000 boilers using solid fuels in residential housing by replacing them with boilers utilising gas or with heat generated by heat pumps.

20 Replacing natural gas heat sources with more efficient types

Common types of natural gas heat sources (primarily boilers with atmospheric burners) will be gradually modernised through replacement for more effective types, such as condensation boilers, or for gas and hybrid pumps.

21 Renewal of electronic goods (white goods, consumer electronics)

A gradual renewal of white goods, consumer electronics, and IT technology. Although the number of electronics in an average household is expected to rise, overall electricity savings are still expected.

22 Use of pressure momentum in the gas network to produce electricity

Installation of an expansion turbine at high-pressure gas regulation station Třebo-

radice capable of producing 2 to 4 GWh/year.

23 Use of wastewater treatment sludges for energy purposes

Sanitised wastewater sludges which are currently removed and transported from the Central Wastewater Treatment Plant in Prague and applied to agricultural soil as fertiliser will be further used for energy purposes.

24 Energy use of waste from ZEVO Malešice

The ongoing reconstruction and expansion of the incineration plant will increase the amount of waste used to produce energy, and with it the effectiveness of heat and electricity production.

25 Setting and monitoring a carbon budget for the city

The city will lay out a carbon budget formed by the volume of purchased and used energy. The materials used for these will be the invoiced supply of electricity, gas, and heat transposed into CO₂ emission, and the gradual reduction in emissions will be taken into consideration. Regulations for capital construction and procuring energy-intensive goods and services (e.g., motor vehicles) will be implemented.

26 City climate fund financed primarily from energy savings

The aim of creating a separate fund is to aggregate resources for financing the individual measures of the Climate Plan. Its goal will also be to provide transparent information about the city's resources utilised for these purposes available to the public. The main income of the fund will be formed from savings possible due to the realisation of the Climate Plan's measures.

27 Expanding the Clean Energy for Prague programme of the Prague City Hall

The current grant programme of the city will be widened to include support for adaptation measures, increased use of RES, progressive renovations complying with low-energy or passive standards.

Sustainable mobility

29 Increasing the attractiveness and capacity of public transport

Continue the introduction of preferential measures for public transport which are crucial for its reliability, travel speed, desirability, and energy efficiency. Renewal and expansion of public transport infrastructure.

30 Information campaign presenting the benefits of sustainable transport

The city will introduce a long-term information campaign primarily concerning the benefits of public transport in Prague. Public transport vehicles will be also used to introduce other activities and areas covered by the Climate Plan.

31 Full automation of metro line C and increasing its capacity*

Investment costs of over 15 billion CZK will bring about major savings in operational costs, higher effectiveness of transport in peak traffic times.

28 Transfer of modern technologies and procedures in sustainable energy

Prague will utilise partnerships in prestigious international projects (HORIZON 2020, ELENA, etc.) to introduce new promising methods and technologies.

32 Construction of metro line D*

Together with automation of metro line C and other investments, this measure will increase the number of transported passengers by 20-25%, that is approximately 100 million passengers a year, and therefore replace individual motor vehicles and public bus transport in the south of the city.

33 Construction of new tramway lines

Following the approved Strategy on the Development of Tramway Lines in Prague.³

34 Increasing the capacity and development of suburban and city railway

The city will work on expanding and electrifying the current railway network within its territory in compliance with the Strategy on the Development of the Prague Metropolitan Railway.⁴ The main priority is the modernisation of the railway leading to Kladno.

³ Strategy on the Development of Tramway Lines in Prague until 2030. Prague Institute of Planning and Development. Prague. 2017. [3]

⁴ Sustainable Mobility Plan for Prague and its Suburbs. Collective of authors led by Prague City Hall (see <https://poladprahu.cz/>). [5]

35 Renewal of carriages in suburban railway traffic and their replacement with higher capacity vehicles

The renewal of carriages and increasing their capacity will allow for an increase in the number of transported passengers on trains of the Prague Integrated Transport network, aiming to reach up to 230,000 passengers a day by 2030.

36 Replacing diesel buses with zero emission electric buses or battery powered trolleybuses*

At least 75% of the public bus fleet operated by DPP or contracted by the ROPID company from private individuals will be replaced with zero emission vehicles (approx. 900 vehicles).

37 Expansion of the core network of bike lanes and protected cycling paths

Construction of new and expansion of current lanes with the aim to increase bicycle transport from 1% in the summer to 4-5% in other times of the year. A gradual separation from other forms of transport and removing the barriers which prevent the development of bicycle transport in the city.

38 Supporting walking

The city's development will be planned and realised in compliance with the principles of a city of short distances. The city will ensure a gradual decrease in the intensity of traffic, development of public spaces, separation of footpaths from different modes of transport, and removing the barriers which prevent the development of walking as a mode of transport.

39 Expanding paid parking zones and increasing the prices of parking for non-residents

Paid parking zones will be expanded to cover other parts of the city. The charged sum will be set dynamically, according to the current demand. The price of parking for non-residents will increase.

40 Introducing an entry toll system in Prague

The Sustainable Mobility Plan for Prague and its Suburbs foresees the introduction of a toll system for motor vehicle transport starting from 2025, based on travelled distance. The possibilities of configuring such a system were evaluated by a feasibility study in 2020⁵ which recommended first introducing fees for an area of 10 km² (so-called option 2), which is frequented by more than 500,000 vehicles. Depending on the charged amount, a decrease of 20-30% in traffic intensity could be expected for the selected areas.

41 Purchase of low or zero emission heavy-duty transport vehicles for Prague Services (Pražské služby) intended for the collection of waste and sorted secondary materials + refilling and charging stations*

Within ten years, the PSAS fleet will undergo a gradual renewal so that at least 75% of energy used is replaced with bio-CNG produced in a biogas station using biodegradable general waste, or with electricity sourced primarily from cogeneration in the general waste incineration plant (ZEVO) Malešice.



In 2019, the Prague City Council approved the Sustainable Mobility Plan for Prague and its Suburbs. This strategic document was compiled over four years in cooperation with experts from Prague and the surrounding Central Bohemian Region. PHOTO: COVER OF THE MOBILITY PLAN + DPP

42 Publicly accessible charging stations and hubs

A long-term project of construction of at least 10,000 publicly accessible charging stations and hubs for electric cars on the city's territory; mainly in public car parks, P+R car parks, parking spaces near highly frequented buildings, on waterfronts for potential use by boats.

43 Support for the construction of hydrogen filling stations and pilot projects for the use of hydrogen in public and individual transport

Prague will contribute to the development of hydrogen mobility by initiating pilot projects which include the construction of related infrastructure and purchase of transport vehicles.

44 Partial electrification of boat transport Supporting the development of charging infrastructure and tools providing suitable incentives and regulation.

45 Support for transformation of air travel towards sustainability

Prague will support reducing emissions from air travel indirectly by urging the Prague Air-

port to lower its emission production in the daily operations of the airport and reduce fees for landing of aircrafts with lower consumption of fossil fuels when calculated per passenger.

46 Construction of P+R parking

Support for the construction of Park-and-Ride parking in Prague, and after discussions with the Central Bohemian region also beyond its borders (e.g. near railway stations in the integrated public transport network would aid in reducing emission and travel congestions which are mostly caused by commuting).

47 Developing carsharing and other zero emission transport services

Support for innovative transport services, such as carsharing, transport-on-demand, and mobility-as-service. These will utilise zero emission vehicles which will then integrate into the city-wide network of public transport (while utilising tools for multimodal journey planning, or unified registration and payment through the Lítačka card).

⁵ Study on the Introduction of a Toll System in the Capital City of Prague. Ernst & Young s.r.o. 2020 (not publicly accessible). [6]

Circular Economy

48 Construction of a biogas station*

Prague will construct its own biogas station in which it will process sorted kitchen waste from households and restaurant food waste. Produced biomethane will then be pressurised into the natural gas network and used in transport. Waste produced by the biogas station – digestate – will be used as organic fertiliser after treatment.

49 More biogas from wastewater treatment sludges

Prague sources additional biomethane from wastewater treatment sludges produced by the Central Wastewater Treatment Plant (ÚČOV). After the finalisation of the intensification project, increase in capacity, and installation of more effective technologies, its production is likely to increase. Biomethane will be pressurised into the natural gas network (today it is used primarily for energy production) and used to power motor vehicles (e.g., the Prague Services fleet).

50 Construction of a modern sorting line for plastic, metal, and beverage cartons

The sorting line in Chřáštany is expected to be finished in 2022. This will allow Prague to further sort its multi-commodity waste collection and allow for more control over recycling of problematic materials, mainly plastics.

51 Introduction of multi-commodity collection of plastic, metal, and beverage cartons

Joint collection of plastic, metal, and beverage containers will increase the share

of recycled goods and lower operational costs of street collections. Partial removal of bins will also increase public street space. A precondition of introducing such a mixed collection system is a full operational capacity of the new sorting line in Chřáštany near Prague.

52 Transfer of the majority of recycling spaces from streets into courtyards (door-to-door)

Expanding pilot projects on the allocation of recycling into smaller containers in shared residential spaces and courtyards will lead to an increase in recycling, free up public space, limit littering around collection points, and lower the operational costs of waste collection.

53 Supporting a "second life" for furniture and other goods

Prague expanded two waste collection points into re-use spaces, where residents may leave their furniture and other items for further use. A construction of a central re-use centre is currently planned, which should also serve as an event space for projects relating to sustainability and for outreach.

54 Approving a strategy for the circular economy in Prague and ensuring the production of regular implementation plans

The city council has assigned the preparation of a strategy for Prague's transition to a circular economy. It should seek further venues for preventing material and energy losses in all industries, for example in construction, forest and land man-

agement, water sources, or waste management. Using all available opportunities could lead to an overall reduction in CO₂ emissions of the city by 2.5%.

55 Capacity building for a circular economy within the City Hall

The city is currently limited by the absence of an expert who could directly coordinate topics and evaluate projects relating to the circular economy across different organisational sectors of the city. It is therefore necessary to create adequate capacities and competencies within the Prague City Hall to continuously introduce the topic of circular economy into the city's daily operations.

56 Establishing the Circular Prague platform

The aim of the platform is to involve companies and use their potential and volunteering activities for Prague's transition to a circular economy.

Adaptation Measures

60 Planting, renewal, and care for trees and tree avenues

The city policy focuses not only on tree planting itself, but also on quality green management & maintenance, as well as on creating of binding Standards on Care and Renewal of Tree Avenues in the Capital City of Prague.

An action plan for planting one million trees by 2026 is being implemented by the city in collaboration with city districts and organisations.

57 Introduce circular principles into Prague's building and demolition sector

Regulations and principles of circular economy will be brought into building, demolition, and renewal methods.

58 Supporting sustainable consumption and prevention of waste production

Prague has approved regulations which will limit single-use packaging and goods during events organised or supported by the city.

59 Ecological and circular public procurement

The city will slowly widen its responsible practices in public procurement into other areas. Effective subsidisation of services, products, and solutions which take into consideration circular economy principles will be included into tender documentation.

61 Revitalisation of parks, green spaces, and planting of vegetation

Establishing new and revitalising existing park spaces which no longer serve their primary purpose, partial transformation of impermeable roads to permeable, revitalisation of lawns, installation of watering systems, planting of trees, introducing quality vegetation care and management. The main aim of the measures is to lower the negative impact of extreme temperatures, heat waves, long-term droughts, and the impact of the urban heat island effect on residents.

62 Establishment of water surfaces, wetlands, river and stream floodplains

A part of the revitalisation process is renewal of meandering streams with pools, sequences of small water surfaces, renewal of meadows and planting of forested areas, creation of dirt road frameworks. The aim of the measure is to accumulate water in the landscape, establish ecologically positive conditions for river courses, support biodiversity, increase green surfaces, and heighten the recreational potential of the urban landscape.

63 Establishing Standards for Rainwater Management

The standards will include proposals for individual technical solutions tied to a typical place of realisation (apartment buildings, industrial areas, tramway rails, etc.). The aim of the measure is to prioritise the use of nature-based solutions as much as possible for the purposes of retaining rainwater in the Prague area for watering purposes, etc. The document should be binding both for the city and its organisations who approve and manage such projects, as well as for developer projects in the city, and as a key resource for new building regulations in Prague. The city should support such solutions, adopt them into its management system, and secure their up-to-date maintenance.

64 Supporting recycling and reuse of wastewater for flushing, cleaning of public spaces, watering and evaporation - cooling of the city

Recycled water may be used for flushing purposes in buildings, for cooling of roofs, facades, and the public space. Sewage wastewater will be used by projects

such as constructed wetlands, wetland bioswales, green roofs, or root system water treatment. These projects lower the surrounding temperature, create green spaces which do not necessitate watering even in hot summer days, or produce clean water for local subsurface water of trees and lawns.

65 Establishment of misting devices, water fountains, and water features in streets

In order to allow for an easier stay in the metropolis' street spaces during heat waves, implementation standards for misting devices have already been compiled and a concept for new drinking fountains has been approved.

66 Gradual transformation of paved impermeable surfaces into permeable ones

Proposed measures plan to replace impermeable surfaces of selected playgrounds, roads, parking spaces, and other surfaces with grass pavers, gravel or dirt paths in order to lower surface water runoff, or to increase groundwater reserves in certain locations.

67 Adaptation measures on buildings (green roofs in combination with the installation of renewable energy sources, and the setting up of vertical or green facades)

Measures include adaptation projects concerning the outer shell of buildings (materials, colours, green roofs, green facades, vertical greenery outdoors and indoors, shading, emphasis on ventilation, use of IT technologies for optimisation of heat comfort in buildings, PV installation,



The project of gentle land management in Prague 12 district (the 2 photos above). Planting of a permaculture fruit orchard, restoration of alleys and foundation of flower meadows helps to reduce soil drying and erosion. The measures also help to increase the retention capacity of the landscape. PHOTO: NADACE PARTNERSTVÍ / VOJTA HEROUT



City greenery increases both the aesthetics and microclimatic value of the intra-urban landscape. The park on Vítkov hill. PHOTO: LUBOMÍR STIBUREK

accumulation of rainwater, systems of grey water use, recuperation of air, etc.).

68 Establishment of vegetation components in the public space (green walls, mobile vegetation, care for courtyards)

Primarily along linear services infrastructure, these features aid in lowering the absorption and accumulation of solar radiation. Free standing green walls function as an adaptation measure against the urban heat island effect. They may utilise rainwater and possess a large evapotranspiration potential.

69 Supporting sustainable agriculture and establishment of community gardens

Prague had terminated all pre-existing rental contracts and approved regulations on organic farming standards for agricultural land in its ownership in 2020. A part of these regulations includes landscape modifications. The city now allows for tenancy contracts only under the condition that such standards are kept. Methodology on community gardens and the Living Courtyards methodology have been finalised in relation to care for courtyards and community gardens.

Summary of benefits and costs of individual measures

TABLE 1 Climate Plan and its main benefits and costs

Area / priority	Reduction of CO ₂ emission (%)		Energy savings			Renewable Energy Sources (production)		Total	From PCH budget	From city owned company budgets	From other sources, including grant programmes
	(%)	(t/year)	(%)	(MWh/year)	(thousand CZK/Year)	(%)	(MWh/year)				
1. Sustainable energy and buildings	39.64%	3,506,039	9.31%	2,263,835	5,267,119	6.77%	1,645,338	174,061	14,842	12,530	146,689
Energy (production and distribution of electricity, heat, and gas)	29.50%	2,608,584	2.72%	661,518	645,845	4.40%	1,070,000	55,055	6,480	12,530	36,045
Housing and building stock	5.01%	442,729	4.06%	987,511	2,201,256	1.08%	262,963	74,086	1,304	0	72,782
Tertiary sector (excluding municipal buildings)	3.35%	296,410	1.85%	449,825	1,683,644	0.82%	198,750	32,020	86	0	31,934
Buildings and other property of the city	1.45%	128,403	0.52%	126,364	588,806	0.37%	91,125	11,050	6,468	0	4,583
Industry	0.29%	25,255	0.10%	25,333	121,000	0.09%	22,500	1,025	10	0	1,015
Street lighting	0.05%	4,658	0.05%	13,284	26,568	0.00%	0	824	495	0	330
2. Sustainable mobility	5.61%	496,468	8.48%	2,063,177	5,022,758	0.00%	0	56,340	17,125	9,876	29,339
Private and commercial transport	4.73%	418,390	7.09%	1,724,364	4,191,911	0.00%	0	10,880	5,950	0	4,930
Public transport	0.80%	70,396	1.38%	336,601	841,502	0.00%	0	45,000	11,025	9,750	24,225
Municipal vehicle fleet	0.09%	7,682	0.01%	2,212	-10,654	0.00%	0	460	150	126	184
3. Circular economy			0.00%	0	0		30,000	600	360	0	240
Use of biodegradable waste in production biomethane*			0.00%	0	0		30,000	600	360	0	240
CELKEM	45.3%	4,002,507	17.8%	4,327,012	10,289,877	7.2%	1,675,338	231,001	32,327	22,406	176,268

*) The benefits of this measure to reducing CO₂ emission are included in the Sustainable Mobility.

Overall benefits and costs of the Climate Plan

FIGURE 4 Breakdown of measures by their CO₂ savings (in %)

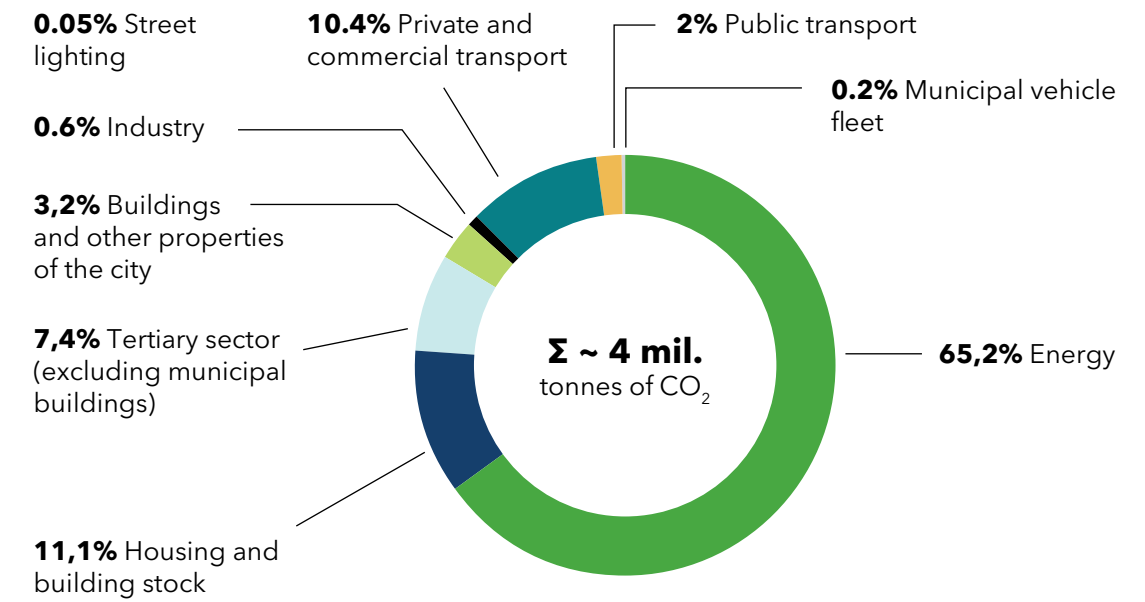


FIGURE 5 Mean annual costs of implementation of the Prague Climate Plan 2030 for the city, city organisations, and selected grant programmes

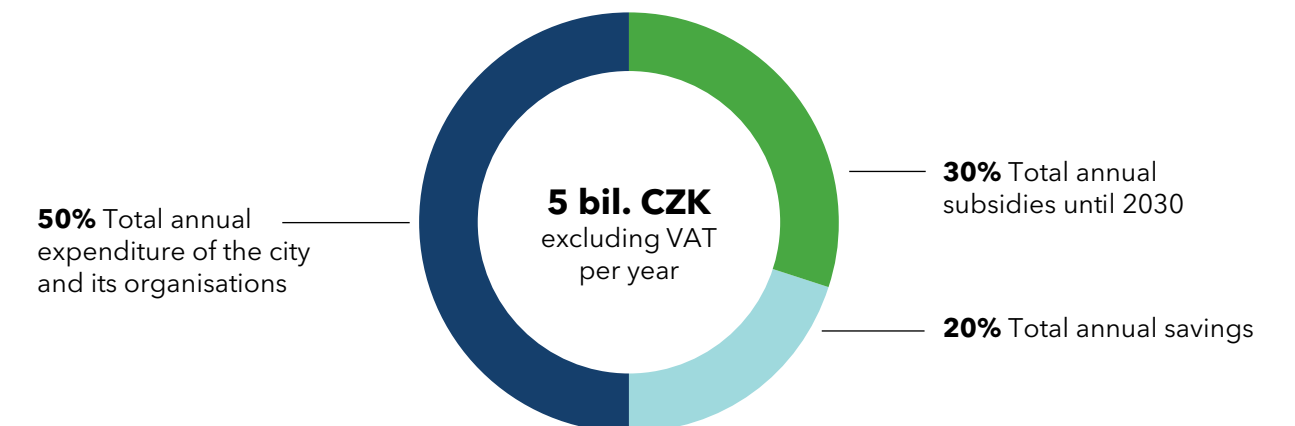


FIGURE 6 Prague's carbon footprint shown by types of energy supplied

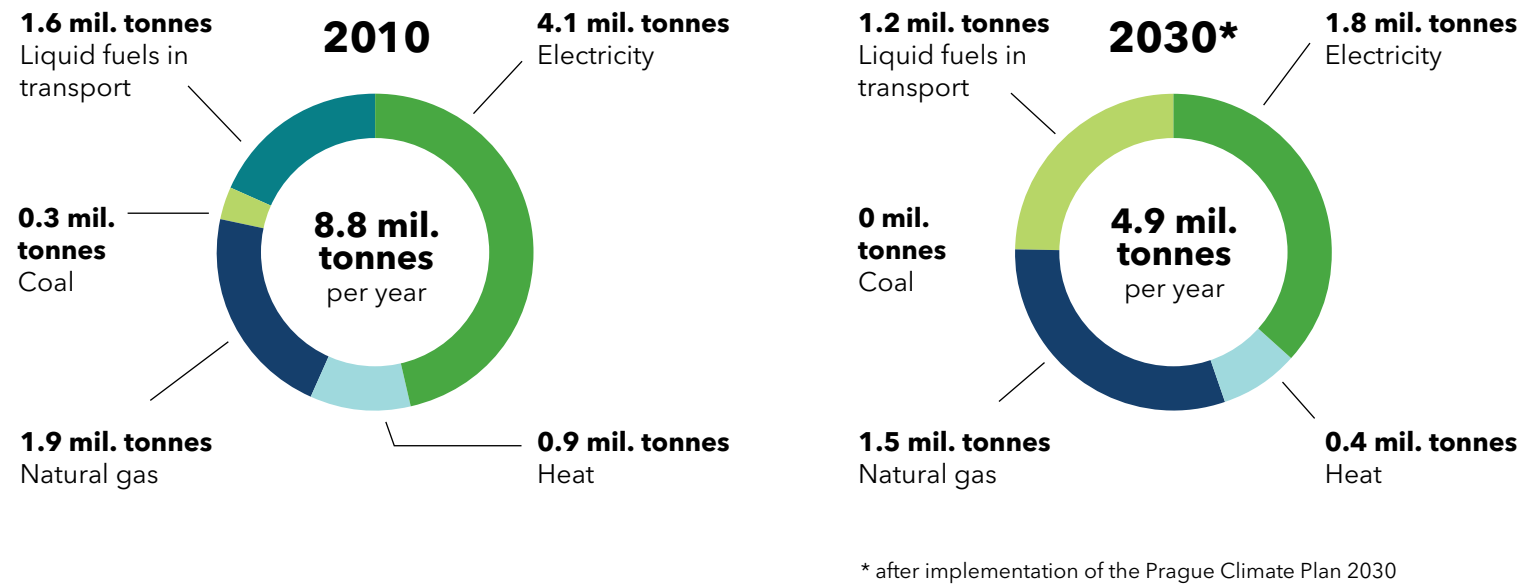
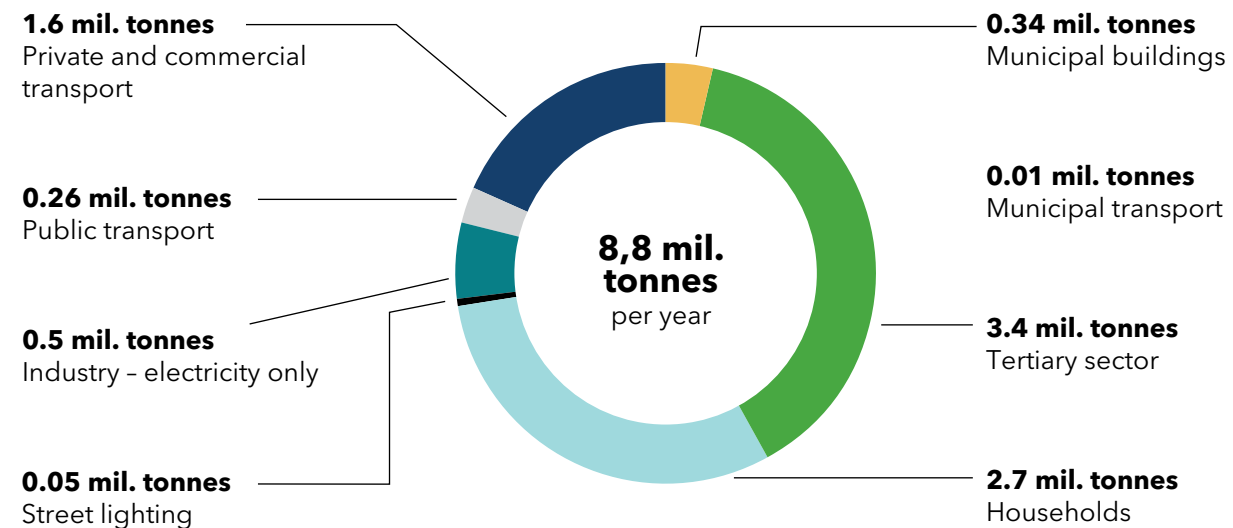


FIGURE 7 Prague's carbon footprint in 2010 shown by sectors of energy consumption within the city



Carbon Footprint

The first phase of Prague's climate pledge focuses on greenhouse emissions originating from the burning of fossil fuels as a result of energy production (for both electricity and heat) or from the end use of these materials. Included are emissions from combustion processes, which take place within the area of the city, as well as outside it, if the produced energy serves to cover its energy demand.

Which CO₂ emissions are included and what is the reference baseline?

The foundation for quantifying emissions lies in possessing excellent knowledge about how much energy in all its individual forms is used in the daily operations of the city. With the help of standardised statistics used by the providers of electricity, natural gas, heat and the intensity of individual types of transport, it is possible to gather a starting energy balance and then re-calculate the corresponding CO₂ balance - the **carbon footprint** of the city - by utilising the so-called emission factors (expressed as the weight of CO₂ produced per unit of a defined form of energy).

Methodological standards set by the Covenant of Mayors⁶ were utilised in these calculations. This initiative, which the city of Prague joined in 2015,

became the guideline for decarbonisation plans for 2020 and 2030 of thousands of other cities within and outside of Europe.

The graphs below illustrate how the individual forms of energy, or consumption sectors, contribute to the **baseline carbon footprint set for the reference year of 2010**.

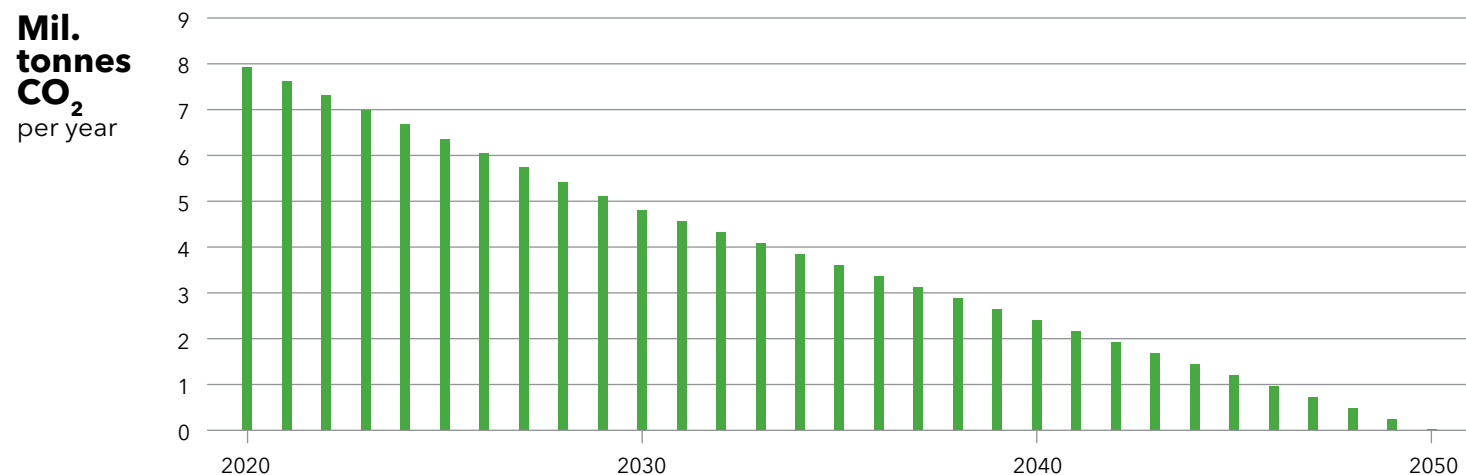
From the above, we can conclude that in 2010 CO₂ emissions reached 8.8 mil. tonnes, that is, approximately **7.2 tonnes** per inhabitant.

However, we the sole focus should not be on greenhouse gases from burning fossil fuels. A considerable share of emissions is created as a result of the purchase of goods and services where the energy used either for their production or provision originated from fossil fuels.

One of the major contributors are carbon emissions "embedded" in construction materials, which are then further used in housing or construction within the city. Other examples are (newly purchased) motor vehicles, as well as other goods which utilise materials requiring extensive energy use (e.g., iron, steel, aluminium, glass, etc.). The place of production may also be a factor - that is, how much energy and emission was spent to transport the goods to the end consumer.

⁶ The Covenant of Mayors is an important European initiative focused on local and regional governance bodies which voluntarily agreed to improve energy efficiency and use of renewable sources of energy in their respective municipalities (see www.eumayors.eu).

FIGURE 8 Planned development of the city's carbon footprint (to reach climate goals)



The volume of these remaining carbon emissions can be traced by compiling the so-called **“emission balance”**.

Statistics⁷ show that the Czech Republic has remained fairly static. While a large percentage of its emissions are exported in the form of goods (which also include electricity), an equal amount is imported. If we consider that the Czech Republic produces more than 100 mil. tonnes of CO₂ annually from the use of fossil fuels and cement production, i.e. 10 tonnes per capita per annum, it indicates how much the carbon footprint per average inhabitant of the city of Prague would have to increase to account for carbon emissions embedded in goods (e.g., almost 3 tonnes/inhabitant/year).

To provide a complete overview of information, it is important to note that greenhouse gasses are also created through processes other than combustion - primarily by the agricultural use of land and animal husbandry, most notably cattle. These types of greenhouse gasses (usually in the form of methane, the negative effects of which are many times higher than those of carbon dioxide) have a significant impact on the carbon footprint of foodstuffs.

This, combined with a higher representation of meat (particularly beef) and dairy products in an individual's diet, can significantly increase the carbon footprint of an average consumer by more than 2 tonnes/person/year.

These other types of greenhouse gas emissions are also quantified and monitored in national statistics. However, defining data within city boundaries remains complicated, and it is not yet possible to establish a reliable way of measuring them. For this reason, such aspects are not currently included within Prague's climate pledge. Even so, methods and preferences of gradually reducing these emissions will be regarded with importance, with the aim to reduce them at the same speed as CO₂ stemming from the need to power the city with energy.

Carbon budget until 2030 (with aims for 2050)

From the climate pledge, we can deduce that Prague should lower its starting carbon footprint, caused by its energy demands, by 45% compared to the data recorded for 2010, and by 2050 reach so-called climate neutrality.

⁷ See for example statistics published by Our World in Data [7]



The Prague Climate Plan 2030 aims at reduction of various types of greenhouse gas. The proposed measures thus include both reduction of the number of cars as well as use of recycled materials in construction (the right photo depicts the workout playground Cukrkandl built from recycled concrete. 2 X PHOTO: JAKUB CIGLER ARCHITEKTI

This in practice corresponds to a reduction of CO₂ emissions to **4.8 mil. tonnes by 2030**, and to a **value nearing zero by 2050**. If we wish to aggregate these goals into values, then Prague should have a “carbon budget” of about 180 mil. tonnes of CO₂ for the entire period until 2050. However, CO₂ emissions between 2011 and 2020 have already been estimated at about 80-85 mil. tonnes, meaning that for 2021-2030 the total CO₂ count should not exceed a limit of 57 mil. tonnes, and for the period of 2031-2050 the aggregated values should be 45 mil. tonnes.

Development during the first decade shows the following trends (valid in 2018):

- Growing consumption of fuels in transport (approx. +7%)
- Moderately growing consumption of natural gas (+4%)
- Decreasing use of (purchased) heating (-10%)
- Stagnating consumption of electricity
- Decreasing production of electricity within the city (-50%)
- Decreasing carbon factor of imported electricity (from approx. 0.73 in 2010 to approx. 0.63 tonnes per MWh in 2018)

The above-listed factors have a positive impact on the development of the city's carbon footprint,

by about 0.6-0.7 mil. tonnes of CO₂, primarily as a result of reductions in carbon demands of electricity production. A significant drop in the production of electricity from coal (brown and black) in the Czech Republic was registered between 2010 and 2019, decreasing by about 10 TWh, more precisely from 47 TWh to roughly 37 TWh. Conversely, an increase in electricity produced from renewable sources grew (by more than 4 TWh), as did its production from natural gas (more than 4 TWh). A slight increase in energy produced in nuclear plants was also registered (approx. 2 TWh).

The vision for 2030 estimates that a measurable decrease in CO₂ emissions from electricity imported from outside the city area will continue at the same rate as the gradual shutting down of electricity and heat plants utilising coal and their substitution with carbon free and zero emission energy sources. It is possible to estimate that by 2030 the specific CO₂ emissions for supplying electricity for Prague through the transmission system should decrease to 0.35 tonnes/MWh. By 2050, we can expect a decrease as low as nearly zero CO₂ emission connected to electricity production. This trend will have a significant positive impact on reducing the carbon footprint of the Capital City of Prague, and potentially also the whole country.

Sustainable Energy and Buildings

The implementation of proposed measures will bring a **60% reduction in CO₂** emissions caused by electricity and heat supply.

CORE PRIORITIES

New electricity plants using renewable sources (so-called RES)

A bold goal for Prague 2030 is to cover all its energy use from minimal or even zero carbon footprint sources.

→ [p. 40](#)

Renewal of the current building fond to achieve modern metropolis standard

The ambitious goal is to create and slowly implement into practice a city-wide system of energy management which would, with little additional funding, identify 3 to 5% of energy savings.

→ [p. 43](#)

New construction as an opportunity for short distances city and as direction via further carbon neutrality

A combination of activities in urban development and planning, as well as construction within the city, will reduce the carbon footprint of new buildings and their life cycle within the whole city area.

→ [p. 49](#)

Reducing the carbon footprint of heat production

Despite the limited possibilities to influence the infrastructure, there are possibilities for Prague to provide more ecological heat.

→ [p. 52](#)

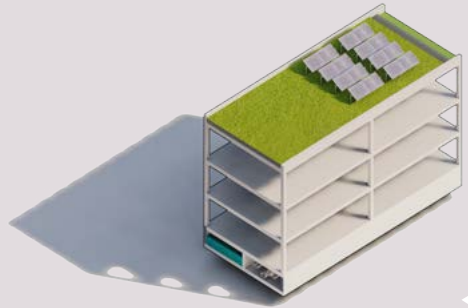
Environmental accounting and the carbon budget

A methodological change in evaluating the environmental impact assesment of large investment projects is the way to change approach of city development.

→ [p. 55](#)

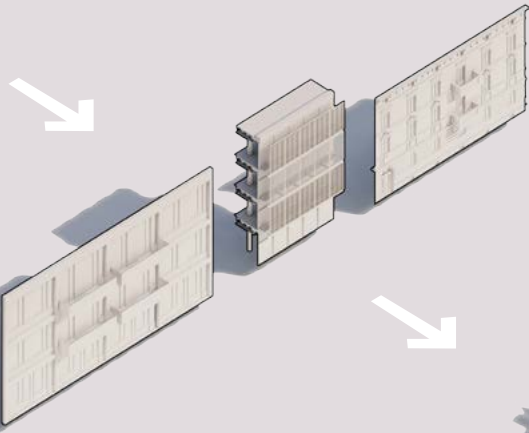
Energy efficient buildings

Technological innovations improve heat management, solar panels generate electricity.



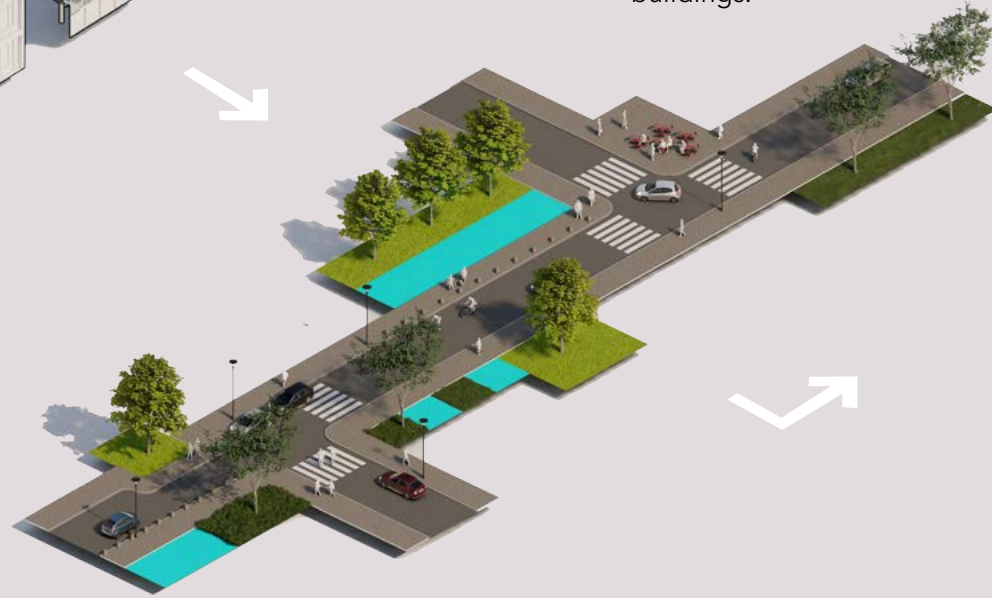
Green and insulated façades

Green façades and efficient insulation systems reduce the energy performance of buildings.



Sustainable streets

Modern street lightning with smart functions saves energy. The microclimate of streets directly affects energy consumption in buildings.



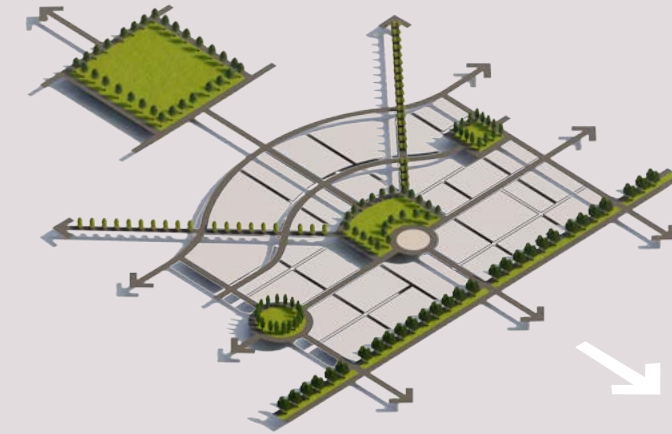
Compact blocks

In general, the more compact is the built up area, the lower are the energy needs.



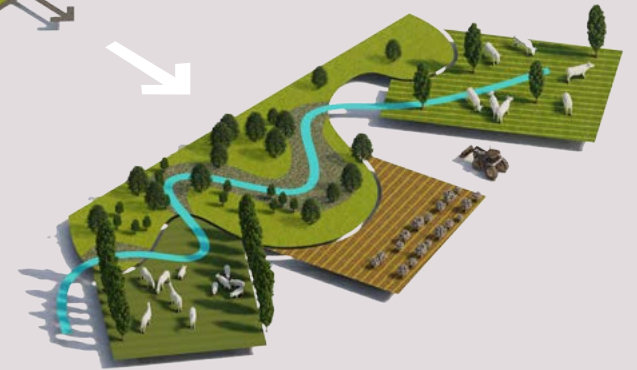
Walkable districts

Sustainable planning is based on the idea of a city of short distances.



Preserved landscape

Compact urban form minimizes land consumption and helps to preserve watersheds, wilderness and farming.



PRIORITY 1

New renewable energy power plants



Prague and its organisations purchase electricity in the open market with the aid of licensed traders, having little influence on what sources are used in the production of electricity.

Prague covers all its energy use from sources with minimal or even zero carbon footprint.

The need for electric power in Prague reaches 6 bil. KWh annually, which equals to more than 10% of the overall electricity consumption for the whole of the Czech Republic (defined as consumption excluding values used for production, losses incurred during distribution, and electricity used during temporary storage in pumped-storage plants). In financial terms, this represents 20–30 billion CZK, the largest portion created by buyers in the so-called non-industrial sector (retail, municipal offices, education, etc.).

The Capital City of Prague ranks among the largest consumers. It owns and directly or indirectly finances (through city districts and city organisations) the operations of more than 6,000 buildings, (railway) public transport, water facility framework, and public street lighting. This results in about 2–3 billion CZK of the city’s budget being spent on the purchase of electricity.

Currently, Prague and its organisations purchase electricity almost exclusively exchanged in the open market with the aid of licensed traders. Every trader in the electricity market is required to inform buyers what sources were used for its production during the specified period, however, buyers essentially do not

have an opportunity to influence the energy mix itself.

While it is possible to acquire so-called green certificates with energy purchases which specify its origin and state that the electricity was produced from renewable energy sources, current rules limit these solely to existing (and state supported) power plants. The purchase of green certificates therefore has little influence on what sources are used in the production of electricity under the current conditions.

If Prague is to reduce its carbon footprint tied to energy consumption faster than the reference scenario of its development (so-called BAU), it must change its purchase decisions in a way which can ensure the establishment of low and zero emission sources of energy.

Considering the viable options, it would be advantageous to utilise the city’s own property as sites for **new emission-free power plants**. A number of buildings owned by the city, as well as linear service infrastructure and land would provide excellent conditions for the installation of solar/photovoltaic power plants (PV).

There are three principal reasons for this first step. The city will be able to demonstrate a social-

ly responsible approach, where significant changes are first begun and made on its own property. At the same time, new PV systems which require significant space for installation will be placed on pre-existing (city owned) buildings and will not necessitate the acquisition of more land, therefore eliminating possible negative impacts on the surroundings and other entities or persons. The third reason lies in the longevity of PV systems which can be, under the right conditions, an economically favourable choice for the city. That is, the reduction of the carbon footprint will also lead to financial savings.

The working group therefore endorses the following steps:

1. Mapping of adequate placements on city buildings and other city property, followed by privately owned property.
2. Verification of technical conditions for installation.

3. Selecting the most economically viable options and proceed with installation (supporting external funding should be utilised when available).

The expected aim is to reach an overall installed power supply on city properties that generates in the higher tens of MW, i.e., with the potential for annual production of tens of gigawatt hours (single digit percentage).

It will be possible to place a much larger number of power generator systems on property in private ownership within the area of the Capital City of Prague. However, this is highly dependent on the economic motivation of inhabitants, as well as a simplification of the current requirements.

A major accelerator of the entire process could lie in the so-called **energy community**, which has already been defined by European legislation as a legal subject, as such entities are gradually implemented into the legal frameworks of individual



Even the historical center of Prague offers a number of opportunities for roof solar panels. The operating building of the National Theatre has a solar power plant installed since 2008, as part of the complex energy savings project. Today, the National Theatre saves about 50% of its original energy costs. PHOTO: NATIONAL THEATRE



The building of headquarters of bank ČSOB in Radlice is an example of sustainable approach. The heating and cooling using an extensive system of heat pumps is especially unique. The building does not need a classic boiler room. Moreover, the complex efficiently uses rainwater, and thus contributes to savings of drinking water. PHOTO: NADACE PARTNERSTVÍ / VOJTA HEROUT

state parties. It is suggested that Prague should establish such an entity in the form of the so-called Prague Renewable Energy Community (Pražské společenství obnovitelné energie, see box below).

It is then recommended to resolve other increases in electricity production from (newly built) zero emission sources and related conditions of contract with the help of the so-called PPA (Power Purchase Agreements). These are frequently used abroad to secure a long-term supply of agreed amounts of energy, including its origin and price, for all parties involved in the contract. Through these tools, it is possible to

pre-define the source of electricity, as well as its price.

A bold, but not unattainable, goal for 2030 is for Prague to cover all its energy use from sources with minimal or even zero carbon footprint. If the development towards reducing CO₂ emissions within the European Union is accompanied by higher CO₂ allowance prices (or even higher market prices of energy), this goal could be reached with minimal additional costs. The attainability of this goal has already been suggested by recent auctions in Germany and other EU countries (auctions are a type of PPA contract, in which the buyer is the state).

Prague Renewable Energy Community

The existence and activities of the Prague Renewable Energy Community should draw on the provisions provided by the European legal framework (specifically EU Directive No. 2018/2001). It should be established by the City of Prague with the aim to accelerate PV installations and possibly additional zero emission sources of electricity, installed in the first instance on buildings in the city's ownership and then followed by other owners.

The Community should play the following roles:

- Developer and manager of newly constructed "green" power plant systems on buildings and other properties of the city or other persons,
- Supplier of other "green" electricity to consumers – members of the community,
- Buyer of "green" energy surplus from systems installed within supply points on city or other property.

With the help of the Community, the city will be able to overcome technical and economic barriers which hinder today's installations of new green energy generator systems. Following legal frameworks outlining the rights and principles of its conduct, it will offer membership also to city inhabitants and organisations with a permanent address within the city. A key condition for membership will be the voluntary use of "green" electricity or its supply, in cases where the person or organisation possesses their own energy generating system.

With increasing numbers of installations and interest on behalf of the city residents, the Community could also offer a financial product in the form of green bonds tied to specific planned installations.



The Renewable Energy Community is a key condition for the increased use of green energy in Prague. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI

PRIORITY 2

Renewal of the current building stock to increase achieving modern 21st century metropolis standard

Over 130,000 buildings in Prague contribute to 75% of the carbon footprint of the city.

A range of measures is implemented, including the energy management and gradual improvement in the standards of renewal for sources of heat. Regulative and motivational tools ensure carbon neutral construction by 2025.



There are over 130,000 buildings within the Prague area which are listed in RUIAN (registry of land identification, addresses, and property) as used for residential or non-residential purposes, of which more than 110,000 are used as living spaces, and the remaining utilised for other purposes.

In terms of numbers, residential family homes have an advantage. Over 65,000 of them were recorded in the baseline year (2010) and their numbers are increasing in hundreds each year. They contain approximately 85,000 residential units. The number of apartment buildings recorded is approximately 33,000, containing more than 500,000 units. The total area of residential buildings in the city was just above 40 mil. m² in 2010 and has been increasing annually by 1% (5,000–6,000 apartments were constructed in Prague during this period).

The energy consumption of these buildings contributes to almost 75% of the entire carbon footprint of the city. Measures in this sector therefore must be extremely ambitious.

The most cost-effective measure is the gradual and precise monitoring of usage of all energies (and water), also called **energy management**. Very often it helps to point out wasteful energy usage and aids in identifying the options of how to lower energy costs to the minimum, or at least to bring them to lower levels. A preconception of quality energy management is a higher frequency of obtaining meter readings and performing data analysis of the information they provide.

An effective long-term solution lies in the automation of **frequent meter readings and their analysis** utilising appropriate software and hardware tools. Prague's strategy is to begin with buildings currently with a power source installed, and then expand this approach to others, including the property of private owners.

The ambitious goal is to create and slowly implement into practice a city-wide system of energy management which would, with little additional funding, identify 3 to 5% of energy savings, that is, CO₂

Energy management of the City of Prague property

In the first phase, the Capital City of Prague intends to focus on properties used directly by the city or by its organisations (approximately 1,300 buildings), later including property given into the care of individual city districts (approximately 5,000 buildings).

The starting energy demands of several hundreds of such buildings are already known due to featuring their consumption sites of electricity and gas in the central market. A couple of hundred others are also monitored for usage of (purchased) heat. Data from invoices for the use of these utilities (and water) are entered into the EnergyBroker programme and further used in statistics and basic monitoring.

Prague intends to expand and improve its system of energy management during the years 2020 and 2021, meaning improving the levels of automation of meter readings (primarily for electric power), and based on currently running pilot projects decide how thoroughly and with what equipment should its energy consumption be measured. The produced insights will be used to find technically and economically optimal ways to automatise the system of energy and water consumption data collection and its subsequent processing. Standards, or indicators, of energy efficiency will be introduced for all buildings in city ownership and their detailed monitoring initiated.

Parallel to these steps, works will begin on the introduction of a system of energy management fully compliant with ČSN EN ISO 50 001. The aim for the next several years is to gradually implement buildings and consumption sites which are now managed by the city districts into the system.

The long-term goal of the city property energy management is to further integrate central energy purchases (not only for electricity and gas but possibly also heat) and reach a more effective coverage of energy demands; further eliminate redundant/

surplus energy consumption reducible through zero-cost measures and improve the medium and long-term plan of renewal and investment which should aid in improving the energy efficiency of buildings.

A key part of the process of introducing quality energy management for Prague's property is appointing an **energy manager** of the Capital City of Prague within the Prague City Hall structure and establish the essential role of such post in activities connected to this topic. The following should be possible with the help of an established energy manager:

1. A complete system of data collection concerning the consumption and production of electric power which can be utilised to propose measures to improve the energy performance and reduce the carbon footprint of the capital city.
2. Complex and unified preparation of investment projects across the different departments of the City Hall which conform to 21st century standards of building renewal (rainwater utilisation, installation of RES and their maximum use in the building itself of those neighbouring it, importance of savings, indoor air quality, maximum synergies of EPC projects and complex renewals, etc.).
3. Regular evaluation of reached energy savings and increasing RES production – presentation of pilot projects aimed towards city districts and other sectors (family homes, etc.) and their replicability.
4. Establishment of a revolving fund based on the evaluated savings which would support further projects utilising RES (interest-free loans for city or residential buildings, sufficient funds for pre-project planning, etc.)
5. Expanding the Clean Energy for Prague project with measures focused on

adaptation, higher use of RES, progressive renewal with low or passive energy standards, and others, including financial aid for pre-project and project planning.

6. Providing complete consultation services for residents (partially financed through the revolving fund) in the field of renewal of residential and apartment buildings (so-called One Stop Shop) including financial support in applying for national subsidies.
7. Transfer of modern technologies and processes in sustainable energy into practice in public administration of the Prague City Hall, primarily in supporting new partnerships in international projects (HORIZON 2020, etc.).
8. Education in the field of sustainable energy, community renewable energy sources, and adaptation measures – regular events bridging culture and education in low carbon technologies.

Through systematic energy management, the city intends to save a large part of its energy expenditure, which should reach hundreds of million CZK annually, if all the above-listed measures and recommendations are applied within the city area.

FIGURE 8 The process of implementing energy management in Prague

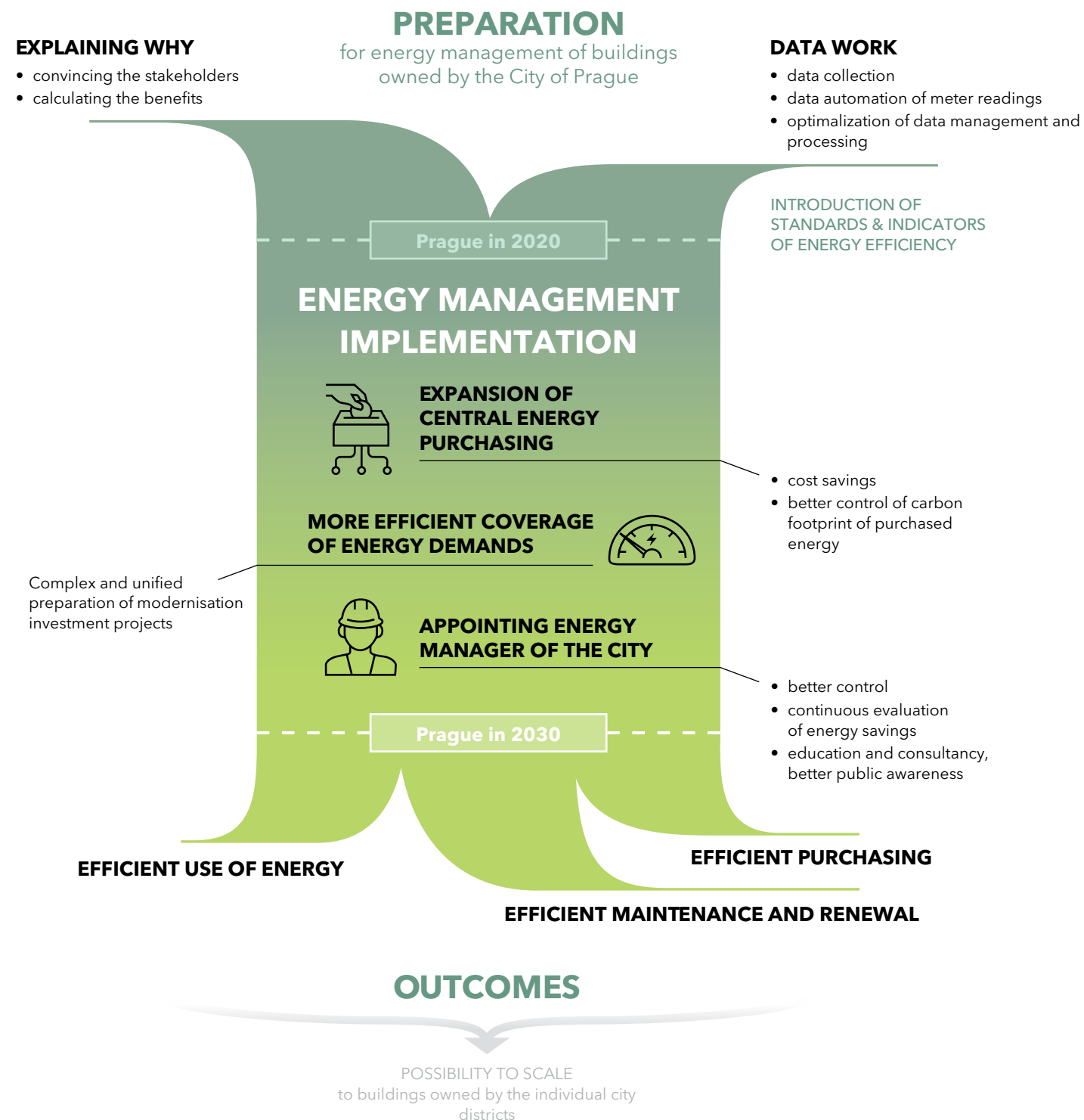
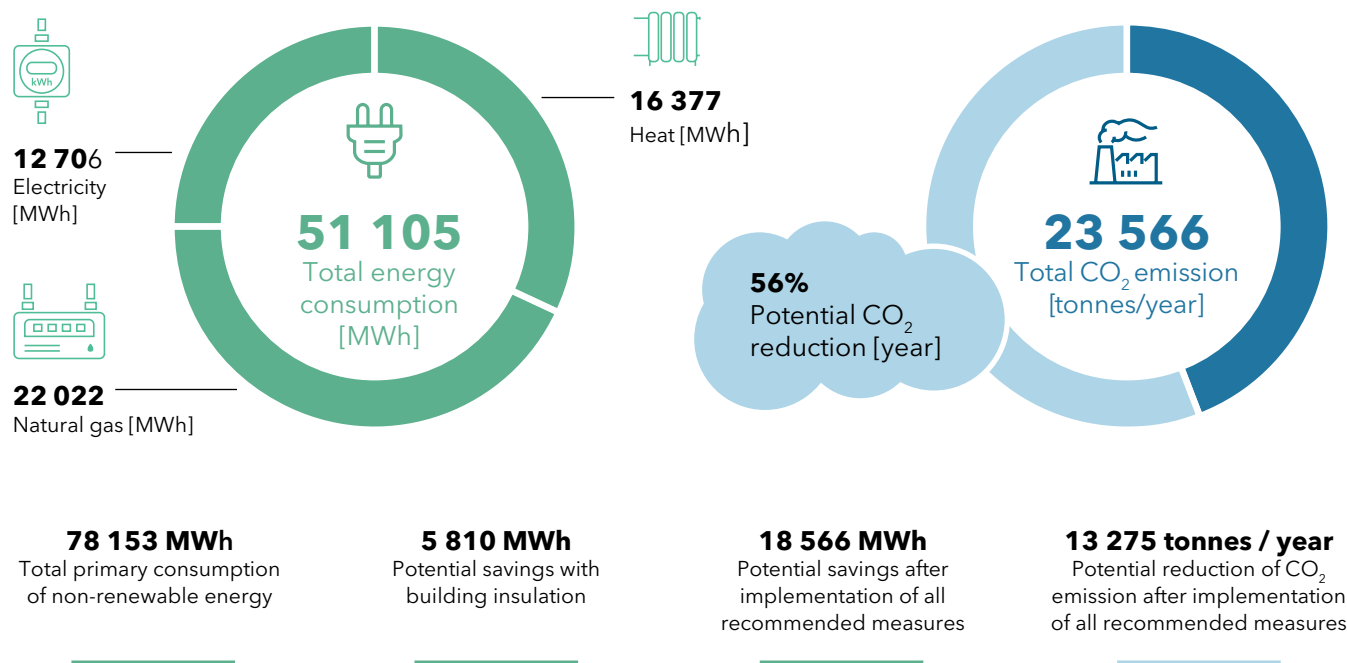


FIGURE 9 Potential for savings in the buildings of the Capital city of Prague



The application of smart solutions to public lighting enables regulation of light intensity according to current conditions (i.e. light intensity or presence of moving person on the street). This not only saves costs, but also reduces light pollution. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI

emissions, in buildings and complement these measures with investment actions consisting of their careful renovation to fit 21st century standards.

Another technically and economically positive measure is a gradual **improvement in the standards of renewal for sources of heat**. It is possible to vastly improve the effectiveness of operations of individual heat sources in the form of receiving stations, as well as boiler rooms equipped with combustion-based heat sources (typically gas boilers). This measure foresees the establishment of standards which will be first applied to the city of Prague and its organisations, and later their expansion to other properties of private owners. Generally speaking, it is possible to reach annual savings of between 7% and 15% on energy supplied for general and hot water heating. A part of these standards will also be a requirement for evaluating the potential of installing a photovoltaic system or a heat pump, especially if the particular building is suspected to necessitate cooling in the fu-



The modernisation of the building of Prague training school COPTH (Centrum odborné přípravy technickohospodářské / Technical and economic training center) is the very first attempt to radically reduce energy consumption of older buildings owned by the city. After renovation, the building would have zero energy balance. PHOTO: ECOTEN / JIŘÍ TENCAR, VISUALISATION: ECOTEN



ture. A combination of these two technologies should be planned and connected with the heat source so that they can be used, individually or together, to prioritise and cover the heat use demand in the summer and winter, as well as in the transition periods. This should further lead to energy savings directly from the heat source. This effect can incur energy savings in the lower tens of percent, depending on the size of both proposed systems, while also positively reducing the starting carbon footprint of the building.

Other savings measures lie in a **better management of the heating system** of individual buildings, installation of **controlled ventilation** with recovery, **modernisation of lighting**, and **improvement of heat-isolation** properties of buildings not only from the perspective of heat losses in the winter, but also as a protection from excessive solar overheating in the summer months. Due to their relatively high investment costs, modernisation is a great option when current equipment and constructions reach the end

of their lifespan, or when using several forms of investment support simultaneously, which should help to facilitate returns sooner than the projected lifespan of the proposed measure. The overall potential of reducing the end use of fuel and energy utilised to cover the heat demand of Prague's building stock may reach up to approximately 30%.

Gradually changing climate conditions in no small way contribute to a decrease in heating demands in buildings. These changes are currently manifesting in more moderate temperatures during the colder months and, on the other hand, also in higher temperatures during the summer. This is the main reason why indoor conditions, especially during the summer months, will necessitate more attention.

Considering the large initial investment and time restrictions, it is realistically possible to lower the initial carbon footprint of the current building stock in Prague through applying energy saving measures of at least 20% by 2030.

Prague can aid this development by (i) implementing stricter internal standards for renewal of properties in city ownership and increasing their numbers/volume, (ii) establishing a “centralised contact point” which will provide free technical assistance with the preparation of renewal projects in residential and non-residential buildings, including advice on possible co-financing from national support and subsidy programmes, (iii) active negotiation of conditions for national support programmes intended for, among others, for interested persons residing within the Prague area and aiming to provide better and more available access to support for applicants, (iv) by continuing and increasing funds provided through the Clean Energy for Prague grant programme supporting the renewal of heat sources, (v) searching for and obtaining financial support from appropriate international funds (e.g. ELENA programme, Innovation Fund, etc.).

While this is not related to the main task, it is equally as important to actively reduce the carbon footprint of future construction projects within the city area. This is because any new building signifies additional energy demands, leading to an increase in CO₂ emissions. Prague should focus, within its means and competencies, on what parameters will be set for new residential and non-residential buildings constructed within the next years in the city area. A key aim should be reaching such standards for new buildings which will lower their carbon footprint to a minimal value, or preferably to zero (so-called carbon neutral buildings). This will allow further city development to not worsen the efforts for lowering the starting carbon emissions.

To reach carbon neutrality for new apartment and other residential housing means to ensure their extremely low energy demand (complying with the so-called passive standard) and simultaneously integrate renewable energy sources (primarily photovoltaic systems and heat pumps) into their construction, or alternatively secure heat, electricity, and gas with zero carbon footprint for the energy demands of the building.

The optimal solution is to evaluate the carbon footprint of the entire life cycle of the building, that is to include emissions which will be tied with the production of the construction material used, emissions tied to the construction process itself, and finally those which will be connected with the building’s eventual demolition.

Examples of how this can be realistically implemented already exist. To generalise, a building’s heat-insulating properties must be very close to the façade of a passive construction while also integrating a large volume of photovoltaic panels. A heat pump should also be installed as a heat source. Alternatively, energy demands for electric power and heat can be solved through a cogeneration unit utilising methane sourced from a renewable source (biomethane) as a primary fuel. In the near future, reduction of the carbon footprint of new buildings should be aided with heat distribution systems with a low CO₂ emission factor per supplied energy unit, the negative impact of which can be balanced with a high-quality building design to balance surplus from a production site obtained from a renewable source.

A part of the above-mentioned measures should therefore also be the adoption of regulative and motivational tools which will ensure that by 2025 all new construction will be carbon neutral at least for the standard expected lifespan (minimum of 20 years).

PRIORITY 3

New construction as an opportunity for short distances city and as direction via further carbon neutrality

Due to the absence of regulations and tools, Prague cannot influence the carbon footprint of private development projects. New construction generally leads to increased energy consumption in the city.

New construction is based on the principles of short distances city. Regulative and motivational tools help to ensure low carbon footprint of all development projects. The city is leading and creates examples of good practice.



Taking into consideration the expected population rise in the city which should, according to Czech Statistical Office, lead to passing the number of 1.4 million inhabitants by 2030 (that is more than 100,000 more than in 2020 and about 150,000 increase compared to 2010), building new residential living spaces and places of public use will be necessary.

For the passive role of the city, new construction would practically mean additional energy usage of all forms starting with higher electricity consumption to fuels used to cover heat demands, and transport which will be utilised by the city’s new residents. A rough increase in Prague’s annual energy demands per person can be estimated to be about 15-20 MWh with a CO₂ emission burden of 5-6 tonnes.

Through appropriate urban planning and construction, it is possible to achieve a significant reduction of these factors – even further, it is possible to transform transport, social, and economic conditions through areas of new buildings in a way which will fulfil the motto: “city of short distances”.

Principles which should be followed for areas of new construction can be summarised as follows:

- Utilise to the greatest extent possible unused land originally used for industrial, agricultural, or similar purposes (brownfields) before building over current green and other areas which can be utilised for outdoor activities.
- Approve large developer projects with the condition of providing good connections to public transport infrastructure. That is, in walking distance from a metro or tramway stop, and do not overlook the establishment of a good non-motorised transport framework (by creating new cycling paths and their connection to the pre-existing network).
- Correctly balance between residential and non-residential buildings and emphasise the accessibility of local public services, referring to the polycentric vision of the city.
- Optimise energy demands of new builds by utilising local low and zero emission energy sources,



In the past, the urban development of Prague often did not take into account the negative aspects of interspersed built-up areas (above) - higher costs for public infrastructure, higher demands on public transport services, inefficiency in energy consumption (to name a few). Sustainable planning is based on the idea of a city of short distances (below). The city of short distances concentrates new development in logical connections to the existing development in order to save space and money for the construction and maintenance of networks. More people and services in a smaller area allow for more visible investment in public space and the creation of more living space. The city of short distances is also a place where it is practical, interesting and safe for everyone to use alternatives to cars.. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI

as well as make sure to underline correct applications of blue-green infrastructure (ratio of green areas and bodies of water, water management).
 → Approve the construction of large malls and other buildings of such type with a condition that a good connection to public transport is made, that is, within walking distance from a stop.

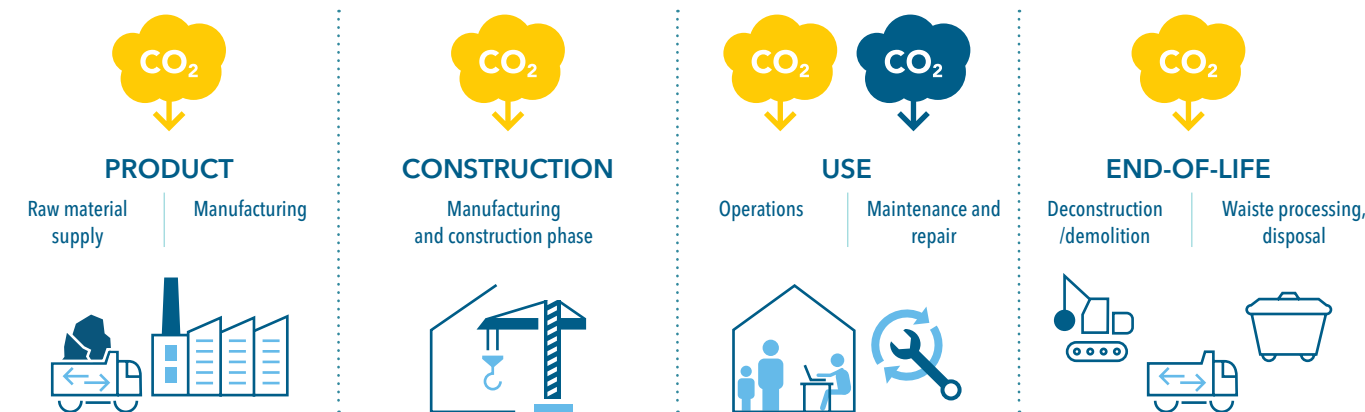
The Climate Plan proposes that new developer projects of a certain size⁸ should be evaluated based on their carbon footprint during phases at which the city may still intervene. It is also recommended to adopt regulative and motivational tools which will help to ensure that every new build within Prague's territory should include a **carbon neutral emission phase in its standard life cycle by 2025** (20-30 years) at the latest.

In cases where this is objectively not possible to attain, progressive solutions similar to those used in London would allow investors to purchase "carbon indulgences" which would be used to finance climate positive measures in other fields.

Starting in the same year (2025) it is then suggested to begin evaluating the carbon footprint of new buildings and their life cycle within the whole city area, that is, including also the emissions generated from the production of construction materials, the building process itself, as well as during the eventual demolition and rubble disposal. It is further

⁸ London may be used as an inspirational example. From October 2016, and fully implemented in 2019, urban planning requires new builds of more than 10 units (from 2016) or non-residential buildings of above 1,000 m² of floor space (from 2019) to include carbon neutrality in their proposed life cycle. Investors therefore have to count with new structures being more environmentally friendly than the current building regulations (by at least 35%) to fulfil this requirement, use district heating or in-house cogeneration units while also utilising renewable energy sources. If the regulatory calculations show that the building is not carbon neutral despite these efforts, the investor is required to pay the equivalent of produced CO₂ emissions during the building's life span (usually 30 years) into a special city climate fund, which are then multiplied by the unit price which the city sets in its operational guidelines (originally £60, from 2021 newly £95 per tonne of CO₂).

FIGURE 10 Types of carbon involved in the different stages of the life cycle of buildings



recommended to adopt regulation and motivational tools which will help to reduce the carbon balance to the necessary minimum.⁹

There are already present ways of reaching these goals. The building must be optimised by evaluating the materials used, as well as the chosen shape and the design concept of its external walls. Essentially, it must be a structure utilising material with low production energy demands, the façade should have very good heat-insulation properties, there should be appropriate use of glass surfaces and adequate adoption of solar power. The energy consumption used for heat and electricity must be covered to the largest extent possible by sources of low or zero CO₂ emission factor per unit of supplied heat. Sections of the building should contain photovoltaic panels in roofs or in the outer walls, and heat should be obtained using heat pumps. Alternatively, it is possible to cover the energy demands of electricity and heat through cogeneration using methane from renewable sources (biomethane) as primary fuel.

In the long-term, heat supply from the district heating framework should also aid in lowering the

carbon footprint of new buildings once it is possible to lower the CO₂ emission factor per unit within the Prague area (see [next chapter](#)). For larger developer projects, the newly constructed heat supply network should work with the lowest temperatures possible and use the possibility to utilise waste heat from cooling in the summer to feed back into this network for further use.

It is advisable to implement the steps outlined above into all activities involved in urban development and planning, as well as construction within the city.

These ways of thinking should also be promoted by the city in its own investments, primarily in construction of residential living spaces. The residential building policy could play a major role; if the city operates with a large enough building stock it could actively influence rent levels, as well as the costs of non-residential spaces, creating positive social and economic conditions for city life. We can again take inspiration from examples abroad (the Austrian metropolis of Vienna is an often-cited example).

⁹ The above-mentioned city of London will use its new urban planning regulations to require appropriate measures for lowering construction material emissions and those related to demolition works (for example, by recycling the materials used at the end of their life cycle).

PRIORITY 4

Reducing the carbon footprint of heat production



More than 90% of Prague's supply of (purchased) heat is generated from fossil fuels

More heat is supplied from the incineration plant of ZEVO Malešice. The city also uses the low temperature heat from the treated wastewater, and utilises effectively the production of natural gas.

To lower the carbon footprint of heat production and distribution is to significantly change the primary source of energy which is used for district heating today. More than 90% of the supply of (purchased) heat is generated from fossil fuels, primarily from coal. If the carbon footprint of heat is to be lowered, it is key to find an alternative to these fuels by 2030. As coal is currently only used in a single source, the Mělník power plant, discussions about its future are unavoidable.

As Prague does not own the infrastructure of heat supply, there are not many options for eco transformation of the future energy mix of its own volition. Yet this does not mean that there are no venues for change.

More heat (in the lower hundreds of TJ) can be supplied into the heat network from the incineration plant of ZEVO Malešice. Its operations are now undergoing significant changes towards more ecological production which will allow it to produce heat and electricity with higher efficiency and in larger quantities (processing capacity of reusable waste will be increased to 400,000 tonnes/year).

The second possible source of heat with a lower carbon footprint could be the **low temperature heat embedded in (treated) wastewater** currently

released into the Moldau river by the central water treatment facility. Production of this further reusable energy currently reaches a volume which could be used to produce a regular output of 150 to 200 MW by utilising high-capacity heat pumps. This would in turn cover up to half (!) of the heat demand generated by Prague households which currently use district heating. It is therefore a source of heat many times higher than ZEVO Malešice.

Similar projects have already been realised abroad and may be used as an inspiration. The aim should be to utilise this project for the integration of the right riverbank metropolitan infrastructure with the main (isolated) heat production systems on the left bank (Juliska, Veleslavín) and therefore create a more robust heat supply system within the Prague area which is capable of fully utilising the potential of secondary renewable energy sources. The above-described proposal can significantly reduce the carbon footprint of district heating in Prague. What more, it can become the basis of a possible future development of district cooling systems.

The remaining needs for heating supplied by the central heating supply system should be covered using **natural gas** in the future while utilising it much

more effectively than is the current standard, that is, so-called high-efficiency cogeneration in electricity production. Due to economic reasons, it will be more viable to construct one or rather two larger cogeneration natural gas heat production plants which will be able to produce electric power and heat at reasonable prices, produce very low CO₂ emissions and other pollutants, as well as operate on a so-called high heat production mode (that is, a high proportion between produced electricity and heat - the most effective plants reach a 2:1 ratio, the standard is 1:1). Cogeneration of electricity and heat should then be gradually introduced even in local (within individual buildings or their complexes) gas boiler rooms, where it should have similar results. This will then be connected to the installation of heat pumps which will become the preferred source of heat for the transition and summer periods.

Prague can contribute to this development by (i) identifying a project which would fulfil the technological and economical needs of further utilising wastewater, (ii) by initiating works on such projects so that it is possible to obtain the necessary permits for this proposal in the timeframe of the next several years, (iii) make active efforts to identify co-financing opportunities from suitable grant programmes for the realisation of this project, and (iv) allow high-efficiency cogeneration using natural gas within the city area while ensuring that emission and other requirements set by the methodological publications of the capital city are met.

However, all of the above is proposed with the condition that the outlined structural changes of the heat source do not cause further increase in prices of district heating in the city (in relation to the economic strength of the inhabitants).

The prices of heat supplied through the district heating systems in Prague are already among the most expensive in the country. A similarly unfavourable picture appears when comparing these prices with those of other large European cities in which the use of district heating is common (when



The incineration plant ZEVO Malešice has a great potential for heat production. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI

comparing the price of heating through buyer power). Furthermore, over 90% of all heat is still being produced from fossil fuels which will continue to be made less accessible in the next decade due to CO₂ emission permits which will only result in more pressure on the increasing prices.

In light of this situation, it appears necessary **to strengthen the city's role in heat production and distribution to prevent further price increase** (and if inflation allows, steadily lower prices of heat). A future continuation of the current preference for district heating in Prague rests on the conditions of eliminating local pollutant emissions but also on CO₂ savings while maintaining reasonable prices.

If meeting these conditions becomes impossible, the use and extent of current heat distribution systems within the city area will lose its economic and ecological advantage and it will be necessary to find suitable alternatives which would be able to provide better results in both key parameters.

Prague wastewater treatment plant as a new city-wide source of heating and cooling

The existence of the Central Wastewater Treatment Plant (ÚČOV) located on the island of Císařský ostrov has, among other factors, one key positive aspect – the water treatment process is a continuous source of low temperature heat energy in the form of treated waste water which is released into the river unused. However, this energy has the potential to be used for heating and cooling purposes, as it is currently done in Helsinki, Stockholm, Oslo, or Zurich, where high-capacity heat pumps operating on the water-water basis provide heat which can be used for both cooling and heating.

The location of the Prague Central Wastewater Treatment Plant in the wider

city centre, that is in the vicinity of residential areas together with existing heat distribution systems, provides a unique opportunity for the implementation of such concepts in the Czech Republic.

In addition, the plant is located in close proximity to the transformation area Bubny-Zátory, which is planned to see the construction of several dozens of buildings with a total floor area of up to 2 million m² in the next 10 to 15 years. The local area could therefore be supplied with heat and cooling from wastewater, thus aiding in a much lesser consumption of primary energy, leading to a lower carbon footprint than would otherwise be possible. The heat potential of the waste-

water treatment plant is so extensive that it would be sufficient to supply the annual heat use of up to 100 to 200 thousand households.

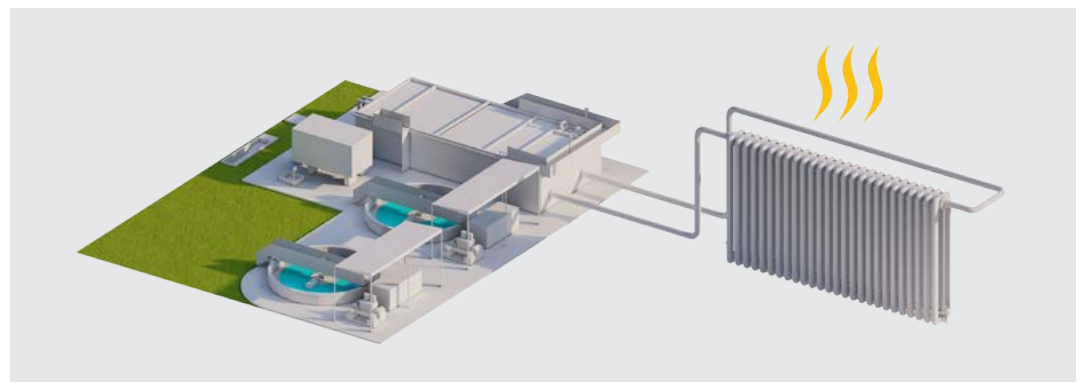
The fulfilment of the Climate Plan in the field of heat production and distribution therefore gains a defined plan of action – to use this energy to its maximum potential. This proposal could aid in integrating other heating distribution systems into a unified whole within the city area as well as offer the option of distributing cooling into the Bubny-Zátory area and later also into the city centre. It is an energy medium which will increasingly become a necessity.



Transformation of the Prague Central Wastewater Treatment Plant into a new source of heat is considered a great opportunity for the city. The location of the plant on an island, further from residential development, makes this idea feasible.

PHOTO: PRAGUE © MARTIN ZEMLICKA /DREAMSTIME.COM

The potential of low temperature heat is already utilised in some European cities. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI



PRIORITY 5

Environmental accounting and the carbon budget



Environmental accounting is not yet implemented in Prague's financial management.

Carbon budget is an inherent part of the annual budget preparation. Moreover, the city has clear guidelines for environmental accounting of large investment projects of private investors.

The first step towards introducing environmental accounting into the city's financial management is to put together an "individual" carbon budget for the city which will be formed from the amounts of purchased/used energies in their respective formats which are regularly financed from the city of Prague's budget. The background will be provided from invoices for electricity, gas, and heat for the previous term which will then be calculated and converted into CO₂ with the help of strictly defined emission factors.

The Prague City Council should propose a decision for this practice to be required as part of the annual budget preparation for the next year in the form of a carbon budget (set by the energy manager of the city) which would be drawing on information from the previous years and priorities Prague's goals to continuously lower it.

The Prague City Council should further propose **guidelines to be followed for large investment projects**, especially in the case of large building projects, and for energy demanding products and services (cars, etc.).

In light of the need to monitor the carbon footprint in the context of its whole life cycle, the LCA method (Life-Cycle Assessment) should become one

of the evaluating criteria. An alternative would be to require "economic viability" assessment for this type of investment and use it to convert proposed aggregated CO₂ emissions into a monetary value with the help of an implicit unit price.

It is further possible to introduce minimum quantification requirements for suppliers of the various services and commodities purchased by the city which will either regulate how each supplier monitors their carbon footprint and whether they try to actively reduce it.

For those institutions which cannot (for technological or financial reasons) lower their carbon footprint in the required range while continuing to with their activities or investments within the city area, a system of carbon footprint offsets should be introduced which would allow them to purchase (certified) reductions from other, economically effective activities. The offset mechanism has been successful abroad in helping to construct carbon neutral buildings. A different version of the same mechanism is to release (authorised) units of CO₂ emission reductions from predefined city initiatives and organisations and offer them for purchase to interested persons and companies, which would allow them to participate in reaching the city's climate goals.¹⁰

¹⁰ This mechanism is utilised by the Canadian metropolis of Toronto which calls it the "Carbon Credit Policy". [10]

HOW TO MEET THE GOALS

List of proposed measures

- 1 **Introduce a system of energy management** and gradually implement it in all sectors of energy use. With its aid, evaluate the effectiveness of implemented measures and research new possibilities. Monitor the fulfilment of the city's climate pledge.
- 2 **Complex and unified drafting of investment projects across the different Prague City Hall departments** which fulfil the requirements of modern renewals of the 21st century, including the introduction of more rigorous internal standards for economically advantageous renewals of properties in city ownership, as well as increasing their numbers/volume; support of these steps will result in an increase in the demand for skilled labour and the number of workers who will focus on putting together and evaluating investments.
- 3 **Lower the city's carbon footprint related to the production and distribution of heat** with the help of an active approach and aim to utilise the gained heat energy from renewable and secondary sources to its maximum potential. This will be supplemented with heat production using natural gas; however, this will only be used in the form of so-called high efficiency cogeneration together with the current electricity production which will allow to fully substitute the production of heat using coal with other methods by 2030.
- 4 **Establish the Prague Renewable Energy Community** supplying energy from renewable sources; first for city buildings and later by expanding to city districts and city organisations in city ownership, and finally to inhabitants and institutions operating within the city. Through this new medium, the city intends to accelerate the construction of new production plants utilising renewable energy sources to cover the energy needs of the city.
- 5 **Establish a city revolving or climate fund** supporting projects of energy savings and the utilisation of RES (ex. interest-free loans for city or residential buildings, sufficient funds for pre-project planning, etc.).
- 6 **Expand the Clean Energy for Prague programme** with measures focused on adaptation, higher use of RES, progressive renewals in low or passive energy standards.
- 7 **Offer complex consultation services** (partially financed from the revolving fund) for inhabitants and residents, providing information about suitable renovations of family and apartment homes (so-called One Stop Shop), including financial support for applying for national grants.
- 8 **Transfer of modern technologies and processes in sustainable energy into practice in public administration** of the Prague City Hall, primarily through partnerships in prestigious international projects (HORIZON 2020, ELENA, etc.).
- 9 **Gradually modernise systems of electricity, heat, and gas distribution**, aiming to introduce smart systems of monitoring (especially in the case of electric power) and reduce losses in the networks, that is, also reduce the carbon footprint of energy infrastructure.

Innovative technologies used in buildings make it possible to significantly reduce operating costs and at the same time reduce the carbon footprint. The Mosaic House Design Hotel in the center of Prague was the first house in the Czech Republic to start using a recuperation system to produce heat from gray water. PHOTO: NADACE PARTNERSTVÍ / VOJTA HEROUT



The modernization of the transmission system is also an important condition for the future development of Prague in the field of energy. The new substation in Karlín is ready to operate within smart grids. The building itself meets high standards for ecological buildings, including a roof with extensive maintenance-free greenery. PHOTO: JAKUB CIGLER ARCHITEKTI

Sustainable Mobility

A technologically and economically attainable goal is to **lower the use of fossil fuels in transport** within the territory of Prague **by at least 25%** compared to 2010.

CORE PRIORITIES

Increasing the attractiveness, capacity, and effectiveness of public transport

The expansion of the metro and tram lines and the integration of train transport has the potential to make public transport the best way to travel around the metropolis.

→ [p. 62](#)

Increasing the attractiveness, capacity, and effectiveness of non-motorised transport

Building safe cycling infrastructure may change the marginal mode of transport into a popular and widely used one.

→ [p. 69](#)

Reducing the intensity of motor vehicle transport (especially in the central areas of the city)

A highly sensitive question of tolls and parking permits has a clear answer in terms of reducing the carbon footprint.

→ [p. 73](#)

Substitute vehicles using conventional fuels with low and zero emission alternatives

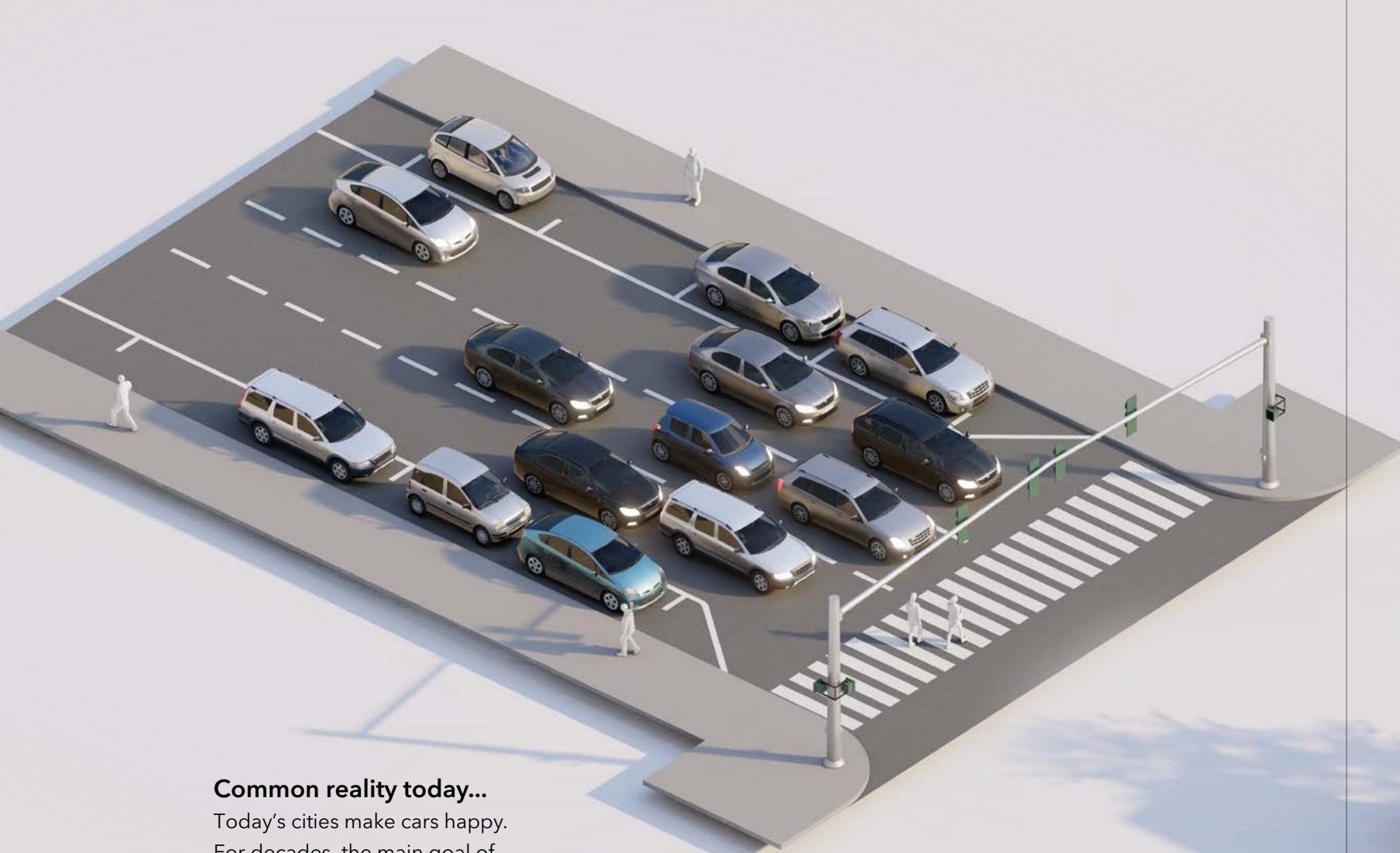
Battery powered electric buses and trolleybuses, hydrogen powered vehicles, emission-free cleaning and garbage trucks... Modernisation of these large fleets has significant impact on carbon footprint reduction.

→ [p. 77](#)

Support the development of sustainable air travel

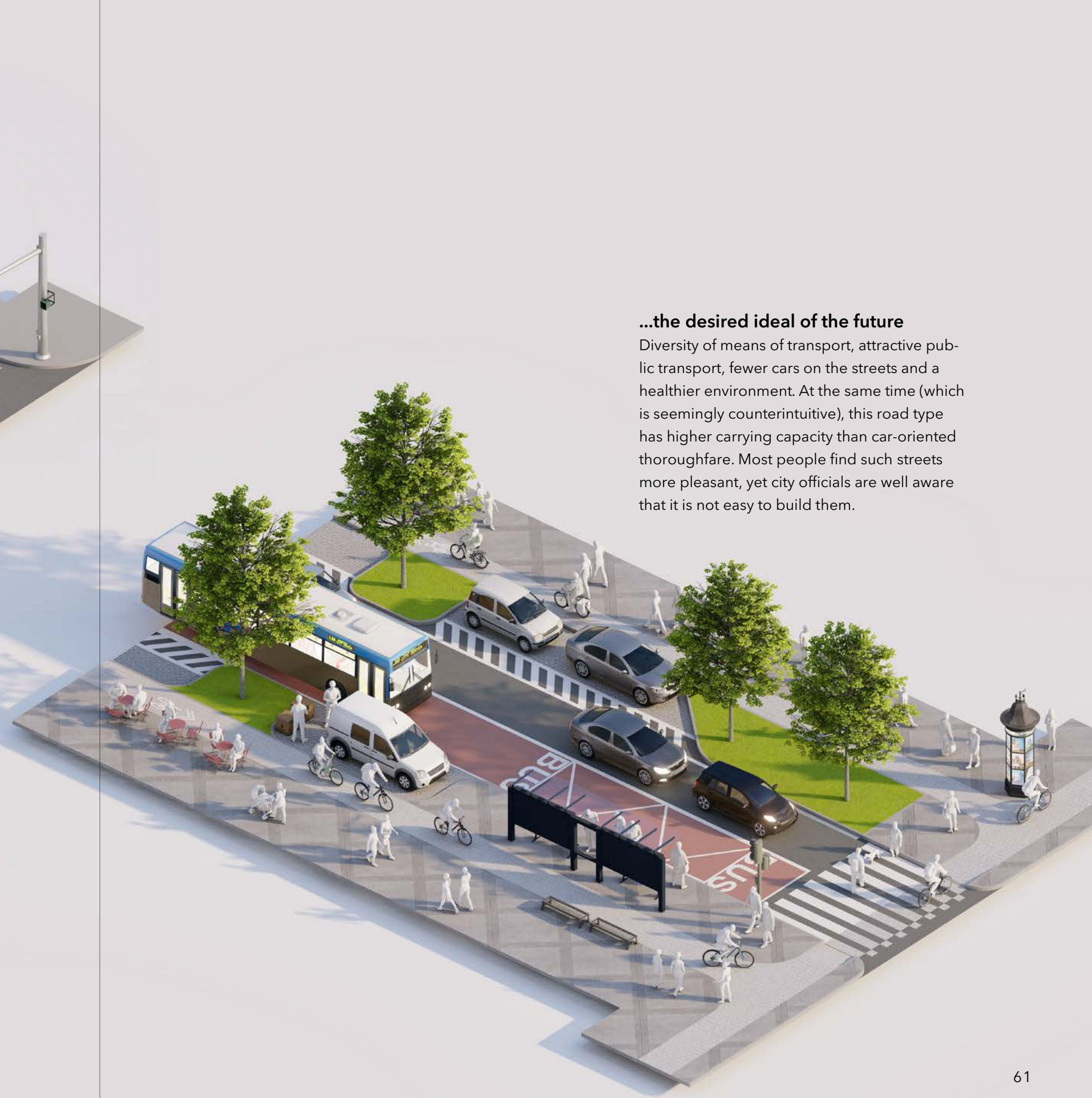
The conservative goal set by the Climate Plan for air travel in Prague is to reduce CO₂ emissions before 2030 by 15% in comparison to the situation in 2010.

→ [p. 80](#)



Common reality today...

Today's cities make cars happy. For decades, the main goal of infrastructure and public space development was to enable the fastest and smoothest possible drive.



...the desired ideal of the future

Diversity of means of transport, attractive public transport, fewer cars on the streets and a healthier environment. At the same time (which is seemingly counterintuitive), this road type has higher carrying capacity than car-oriented thoroughfare. Most people find such streets more pleasant, yet city officials are well aware that it is not easy to build them.

PRIORITY 1

Increasing the attractiveness, capacity, and effectiveness of public transport



Despite having one of the world's best public transport systems, there is still 30% of people preferring individual car transport.

The construction of new metro line D, the development of the tramway network and the more intensive involvement of trains in the public transport system significantly increase the capacity and comfort of public transport. Individual car transport within the city is minimal.

Public transport in Prague contributes significantly to the overall transport services of the city. The metro, tramway, bus and railway lines are used by more than 3.5 million people every day which accounts for more than 40% of all passenger transport in the city.

In a year this equals to more than 1.2 billion passengers. The highest frequency use is of the metro (approximately 440 million passengers in 2018), followed by buses (over 400 million including suburban lines) and tramway (approximately 370 million).

The overall number of transported passengers has risen slightly since the beginning of the decade (by 60-70 million) but this increase was primarily covered by buses (increase of almost 50-60 million passengers) while the efficiency of rail-based travel is stagnating (even though the numbers of kilometres driven are increasing and metro line A was extended by approximately 6 kilometres closer to Motol).

The sustainable mobility plan "P+" predicts that by 2030 the share of public transport should be at approx. 42% while the reference scenario saw a minor decrease to 40% (as part of the total share of public and non-motorised transport in overall transit performance).

How to maintain such a high ratio of public transport can be summarised in four concisely formulated conditions: public transport must be financially accessible and when compared with motor vehicles (if possible) equally as fast, comfortable and user friendly.

However, the real-life application of these is often expensive, which is supported by the rising financial resources used by the city every year to fund transportation.¹¹

From the perspective of the Climate Plan, public transport and its (increasing) efficiency is a key presumption for reducing the carbon footprint of the city.

¹¹ The so-called compensation for providing a public service paid to transport companies operating public transport lines within the Prague city area reached 16.5 billion CZK in 2019 (which made up 20% of all city expenses), while in 2012 it amounted only to 12 billion CZK. The city thus reacted to increasing mobility and volume of transport (number of total kilometres in the transport network rose by more than 12% between 2010 and 2019). However, income from transport fares is stagnating (this covered approx. 20.5% of all costs in 2019 but in 2020 this was already less than 15%, while in 2010 this was around 25% in comparison).

To successfully resolve these perceived conflicting elements, it appears crucial to pay increased attention to energy and economic efficiency – that is, how to transport as many passengers as possible, with as little (variable) energy costs.

In these comparisons, the metro currently seems to lead, as it is able to transport the most people per unit of used energy (KWh. MWh). Due to a significant part of electric power used for metro operation being unrelated to the number of passengers it transports, it is desirable to search for methods which would increase its transport capacities, including prioritising new residential family and apartment home construction in areas near its stations (that is, providing the opportunity to effectively use non-motorised transport for residents).

To retain its (economic) feasibility, the Climate Plan therefore anticipates a priority focus on such measures which will aid in the increase in the volume of passengers transported via the metro lines as opposed to other forms of public transport (and, of course, as opposed to private motor vehicles) where financially possible.

The **ongoing works on metro line D** and the **extension of line B into the Zličín depot** can both be considered to be transport projects with good potential to be finished by 2030 without additional support from the Climate Plan of the city. Despite being expensive investments without a secure source of funding, they provide a great opportunity to increase the efficiency and performance of the process of automation of current metro lines and their cars. Automated metro lines can be found in dozens of world cities and their numbers grow higher every year.¹²

Line C could be fully automated in this way by 2030, which would also be suitable due to the plans for line D as unmanned. This would necessitate acquiring train sets capable of driverless operations,

¹² The overall length of fully automated metro lines is now over 1,000 km and is expected to double by 2025. In Europe, the first city to introduce a driverless metro was the French city of Lille. Nowadays, one or more automated lines are operating for example in Barcelona, Copenhagen, Nürnberg, or Paris where a new automated line will be operating on the ring line „Grand Paris Express“ led along the outer perimeter of the city; after its finalisation in 2024 with a total length of 200 kilometres and 68 stations it will become the longest in the world.



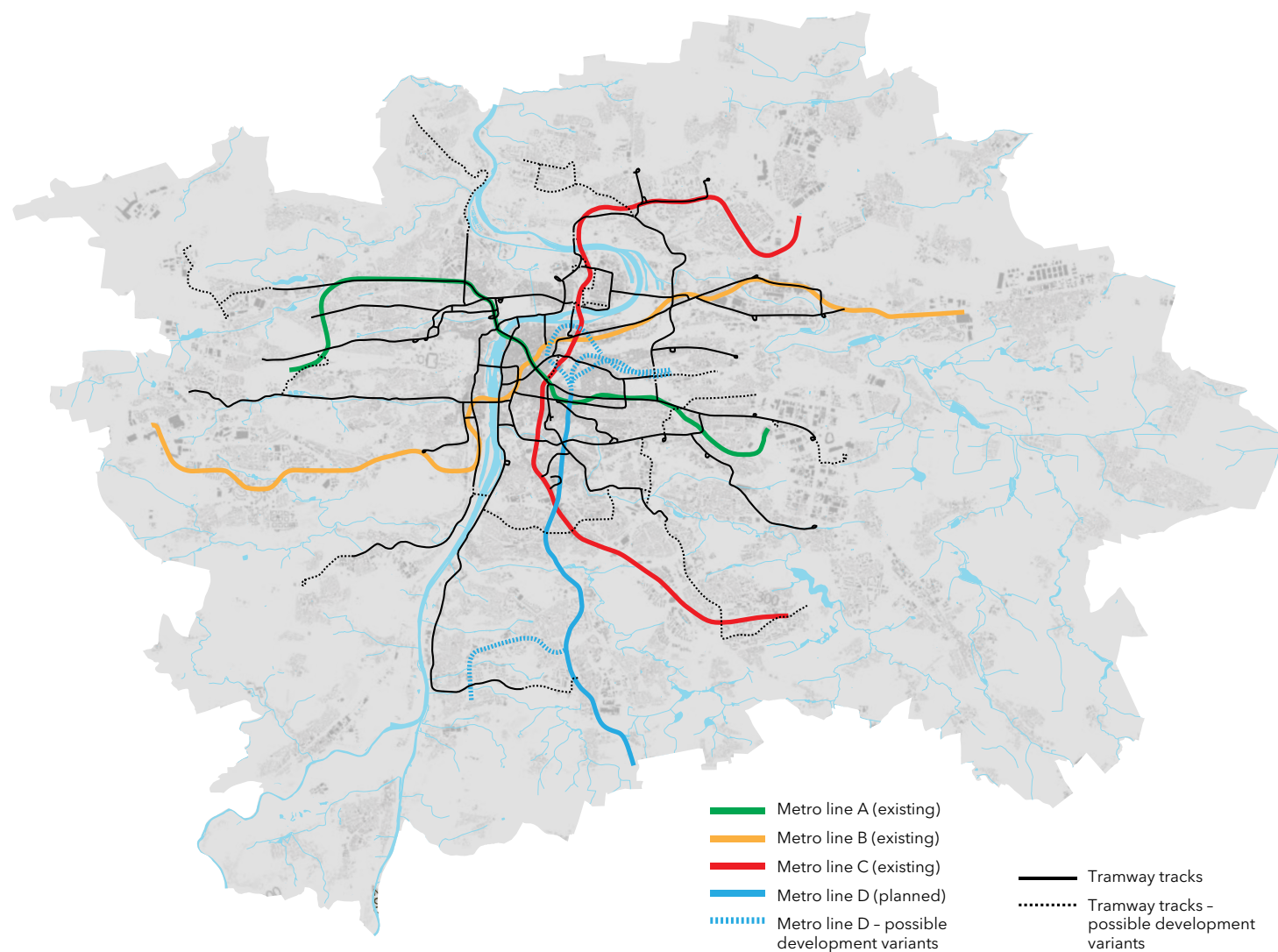
The fourth line of Prague metro Metro is planned as fully automated to maximize the transportation capacities. SOURCE: DPP

a new signalling and safety system for their operations (so-called CBTC system) and changes to station platforms.

Automation will allow for shorter intervals during peak traffic times and therefore increase transport efficiency (by approximately 20-25%). Furthermore, it will increase the overall safety of travel due to the installation of protective glass along the entirety of the platform. Lastly, it will minimise the staffing needed for the operation of the metro which will become less and less affordable. The result would be an increase in the number of passengers transported compared to the current state. Metro carriages which now operate on line C (over 260) could be transferred to the other lines depending on their age and status which would also aid in improving travel in the remaining parts of the infrastructure.

If the above-described measures are successfully realised, it will be possible to increase the number of transported passengers above 550 million per year

FIGURE 11 Planned development of the metro and tram network in Prague



by 2030 (whereas now it remains at approx. 440 million). It would also be possible to increase these numbers in the future by automating the remaining lines.

It would be beneficial for the entire transport system for these new passengers to be acquired from individual motor vehicle transport and bus lines (which the expansion of the metro will allow). Due to the metro being a form of transport with the largest measurable fixed costs while buses incur the largest variable costs, the change of infrastructure will have a positive

impact on the economics of operations in the public transport sector for the city.

From the perspective of further reducing the carbon footprint of the city, it is similarly important to support further **development of tramway transport**. If the city budget and lengthy process of approval of new construction allows, it would be possible to expand the tramway network according to the approved strategy¹³ by more than 10 km until 2030 (in the phase of preparation are about two dozen projects of total

¹³ Strategy on the Development of Tramway Lines in Prague until 2030. Prague Institute of Planning and Development. Prague. 12/2017 [13].



The development of tramway transport is important for reducing the city's carbon footprint, Prague therefore plans a number of projects. In the past, the development of tramway network stagnated, the section from the Pražského povstání to Pankrác (left) opened in 2020 was the first extension in nine years. PHOTO LEFT: JAKUB CIGLER ARCHITEKTI / PHOTO RIGHT: DPP

length of 30 km of new tracks, that is more than 20% of the current overall length). This would increase the number of passengers who could be transported by the lower tens of million: while today it is approximately 370 million passengers, the attainable goal until 2030 would be to increase this to 400 million.

The increase of the efficiency of tramway transport (and public transport generally) could further be reached by extending the tramway network outside of the city into selected points in the Central Bohemian region which do not currently possess a connection with Prague. However, due to the very high initial investment currently the only economically feasible project will be the Kobylisy Depot – Zdiby line which should be longer than 5 km and include two P+R terminals. With other potential lines (to Vestec or Jesenice, further to Průhonice and Čestlice or Hostivice, etc.) the alternative would be a “lighter” electrification in the form of battery powered trolleybuses with a much higher capacity than conventional buses. If at least some of the intended connections were able to be realised with a separate bus lane (known abroad as the Bus Rapid System), it would be possible to vastly improve their average speed and with it the interest of potential passengers.

Before 2030 it is also possible to expect first attempts at automation of some of the line with respect to the expected technological advancement in autonomous driverless tramway systems.

It is also necessary not to forget the main advantage of public transport which is crucial for its reliability, that is also attractiveness and energy efficiency (for example smooth crossing over traffic lights for public transport or common sectors with private motor vehicle transport). A key element is also the renewal of the current infrastructure for example in the revitalisation of current transfer terminals.

A large improvement and increase in the number of transported passengers will also be possible by 2030 by **expanding the suburban and urban railway network**. The “S” lines were used during working days by approximately 160,000 passengers which are primarily those who would otherwise use a bus or private motor vehicle to travel. By 2030 it should be possible to “gain” up to twice the number of passengers for this more sustainable mode of transport.

The way to achieve this goal is again through the modernisation of the railway infrastructure and vehicles. As the infrastructure is financed by the state

through the state-owned Správa železnic (SŽ) company, the city is solely in the position of building approval and preparation processes.

Due to the large number of different potential investments in the railway network until 2030 within the Prague area which should increase its capacity (see box below), it would be meaningful for the fulfilment of the Climate Plan to create a position of the coordinator for railway infrastructure who should aid in taking the right preparation steps in the name of SŽ and aim to speed up the process accordingly. New construction in railway infrastructure now can be proposed according to the Amendment to the Act No. 416/2009, Coll. dating to 1 January 2021, in a joint regional governance and building approval process with shorter deadlines (if the relevant administration authority does not present a binding opinion in the required time, it is no longer relevant in the process). The approval process for transport infrastructure may be further initiated with limited project documentation, as it is currently possible to request an interim decision in the form of withdrawal or limitation of the right of ownership or corresponding to an easement. Structures which stretch over several city districts may be approved directly by the Building Authority as part of the Prague City Hall. All of this should lead to a faster process of building preparation.

A second major step is to gradually increase the quality standards and capacity of railway carriages. In 2019, Prague closed a new 10-year contract with České dráhy (Czech Railways) as a supplier of the public service for the "S" lines. This new contract will gradually require (the supplier) to complete the above listed conditions, which sets a step in the right direction. Aside from higher standards for hygiene, visual appeal and timeliness, the contract also includes requirements for their higher capacity.

While the currently deployed three carriage single-level units of the 471 line are capable of transporting over 300 seated passengers (and twice the amount in a two-unit connection), the future desired numbers should be 400 to 800. Within the duration of

this contract, ČD should begin to supply its services with the help of new (or reconstructed) carriages of this capacity in more than 50 units. However, it will be necessary to alter some train station platforms (trains of this two-unit capacity tend to be longer than 200 metres, which is above the today's capacity of certain train stations in Prague's vicinity), as well as increase the financial instalments paid to the supplier.

For this reason, this measure is included in the Climate Plan as having an aspect of "additionality" aiming to find a source of financing for its realisation. The costs of new units with a larger capacity can be estimated to be about 15-20 billion CZK. The agreement foresees also the purchase of smaller (single deck) carriages which will be deployed to less frequented lines.

For the purchase of new vehicles, both parties to the contract agreed to use the opportunity to co-finance parts of the initial costs from available grant programmes of support which will provide a good opportunity to bring this proposal to implementation. It is necessary that Prague provides the necessary cooperation with the carrier so that the submission of the grant applications is possible and successful. This would significantly reduce the rising compensations for the railway operations and Prague would be able to raise the interest in the S lines with new carriages while also reducing motor vehicle traffic.

The increase in transport capacity in peak times could be attained by introducing the ETCS safety system in the so-called level 3 which allows trains to communicate with each other; this can then reduce intervals between connections. However, the current intention on behalf of Správa železnic is to introduce a system one category lower (ETCS 2) primarily for reasons of absence of communication units in the current vehicles (OBU ETCS). With gradual modernisation of the fleet it is possible to expect a possible transition to ETCS 3, which would be a good opportunity for Prague's suburban travel to further its efficiency.

PRIORITY 2

Increasing the attractiveness, capacity, and effectiveness of non-motorised transport

Due to lack of infrastructure and public support, cycling makes only 1% of all transport trips during a standard working day.

Prague has a long-term budget dedicated for the development of pedestrian and cycling infrastructure. Increased safety of bicycle transport makes it a popular alternative to individual car transport.



Non-motorised transport is an umbrella term for bicycle transport and transport on foot. The share of non-motorised transport in the overall sector statistics is relatively high (reaching 27%), however, walking dominates (26%).

Transport of foot now makes up a large section, however a rise in its popularity might simultaneously lead to an increase in the preference for public transport (see [Priority 1 of this chapter](#)) above that for individual motor vehicle transport. This is due to walking being an inseparable part of utilising public transport. Year 2020 proved that not only can walking be an effective mode of individual transport but from an epidemiological point of view also one of the safest options for keeping in good physical and psychological shape during the difficult times of the COVID-19 pandemic.

Cycling is also a highly desirable mode of transport for the fulfilment of the vision of a climate responsible city, especially for distances in the single digits of kilometres (for example between place of residence and the workplace, for the so-called last mile from the train or metro station, etc.) where it can

be an efficient substitute for motor vehicle transport. Every kilometre driven on a bicycle lowers the overall amount of CO₂ emissions produced by motorised vehicles (produced by the burning of fossil fuels) by dozens of grams (as opposed to a bus ride) or more (compared to driving a car). In many European metropolises, cycling represents a much higher ratio of the main modes of transport used than it is currently true in Prague (the most successful is Copenhagen with 28% of all transport trips during a standard working day while in Prague this remains just 1%).

The number of bicycle trips in Prague is, however, experiencing an increase and in the last several years has been pushing at 4 million per year. This trend was accelerated by the start of the COVID-19 pandemic in the spring of 2020, when the bicycle became a well-received alternative to individual motor vehicle and public transport in the city.

The realistic goal for 2030 is to increase the number of trips realised by using a bicycle within the city area to 15 million a year and thus increase the share of bicycle transport to 7% in the summer months and transition periods, and 4-5% in the remaining times



In order to become a bicycle-friendly city, Prague needs to complete the necessary infrastructure. The key factor is the safety of cyclists in traffic. The biggest contributors to safety are cycle paths separated from car traffic, or at least dedicated cycle lanes on roads. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI

of the year (the Sustainable Mobility Strategy now expects approximately 3%).

In comparison to the number of passengers able to be transported via modes of public transport (almost 1.3 billion a year) or individual motor vehicle transport (similar numbers to public transport) the opportunities are much smaller, however, every improvement is a welcome contribution to reducing the city's carbon footprint. The transfer of sections of passengers to bicycle transport will also bring a highly desirable reduction of space in public transport vehicles which will open the opportunity to travel to a larger spectrum of Prague's inhabitants.

The realistic goal for 2030 is to increase the number of trips realised by using a bicycle within the city area to 15 million a year and thus increase the share of bicycle transport to 7% in the summer months and transition periods.

However, the increase in use of non-motorised transport is not guaranteed and is determined by better safety and infrastructure for cycling and walking within the city.

By utilising examples of good practice from abroad and having the courage to apply unconventional solutions in the Czech environment, together with a consistent effort to continuously improve the conditions for further development of the city, it will be possible to keep improving the conditions for cycling and walking as a mode of transport in Prague.

If the measures listed below are implemented by 2030, it will represent a major positive step of the city towards this space saving an ecological form of transport. Furthermore, as studies from abroad



Small measures that remove various obstacles from public space often help to increase the attractiveness of walking. Safe pedestrian crossings, short intervals at traffic lights, or removal of unnecessary railings are just few examples. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI



Náplavka (the Embankment) on the right bank of the Vltava river is a popular place. Ensuring a safe cycling passage through Prague in the entire section along the river is one of the important tasks for the future development of the city.

show, the development of such infrastructure will have a positive impact on life in the city - the quality of use of public space will increase, the desirability of properties will rise and lead to further business developments.

For this reason, it is necessary to approve a long-term binding financial plan (budget) intended only for the development of pedestrian and cycling traffic in Prague. It will then be realised by 2030 funded with the help of the city's budget allocation and available national and international grant schemes and programmes. It is recommended to set its value at 5-6 billion CZK at the lowest (aggregated value by 2030). Exact prioritisation of the investment plan for further development of bicycle infrastructure in the city should be set in reference to the Prague Strategy for the Development of Non-Motorised Transport 2022-2030 and its action plans.



An important project for greater pedestrian comfort was the construction of crossings on Charles Square in 2020. Until then, pedestrians had to use the underpass. PHOTO: JAKUB CIGLER ARCHITEKTI



The growing popularity of bikesharing in Prague led in 2021 to the launch of a pilot project to integrate shared bicycles with the public transport system. If the project proves successful, it will be possible to use the Lítačka transport card to rent bicycles in the future. PHOTO: ANTONÍN KEPRTA, OCP MHMP

Major projects in the development of bicycle transport in Prague proposed for realisation before 2030

Among the new “backbone” of cycling paths represented by the “AX” category, the realisation of which could have a major positive impact especially on the rise of awareness of cycling as a mode of transport, and which are therefore recommended for initiation and realisation in the standard of protected communications with priority and separate paths for cycling and walking, are the following listed in the Overview of cycling paths in Prague:

- Path A3, starting in Hostivař and led through Strašnice, Vršovice, Nusle and over the railway bridge to Smíchov (Vršovice railway promenade);
- path A4, proposed from the city centre to Pankrác and to Jižní Město;
- path A5, starting in Dolní Počernice and led along the railway past the Praha-Libeň railway station towards the main train station and further towards the Vršovice railway station;
- path A6, connecting future development of Bubny-Zátory with Veleslavín

and continuing on to the Central Bohemian Region and to Kladno;

- path A9, the so-called North-East cycling trunk road which would begin in Libeň and end in Horní Počernice.

Other measures which should be implemented in support of non-motorised transport in Prague:

- The modification of current “backbone” cycling paths A1, A2 to the standard of protected, that is separated from other vehicle transport, path with high quality surface along its entirety, with sufficient width and safe connections to other backbone paths.
- Expanding the speed limit of 30 km/h to the as much urbanised area as possible while also installing retardant elements to slow down traffic.
- Continually secure preparedness of newly constructed public spaces for current and future development of pedestrian and cycling traffic.

- A re-dividing of public space with the aim to achieve a safer permeability of the city for pedestrian and bike transport.
- Unification of good practice in cycling and pedestrian infrastructure across city districts, investors, project authors, suppliers, and organs of state power.
- Strengthen the power of the city in managing micro mobility within the legal framework.
- Adding safe and functional infrastructure connections for pedestrian travel.
- Pressure changes in legislation and lifting of norms restricting bicycle infrastructure.
- Gradual addition of P+R parking at stations and train stations of rail transport.



Visualisation of the planned cycle path along the Vltava embankment in today's dangerous section around the National Theater. SOURCE: IPR PRAGUE



Visualisation of the planned pedestrian and bicycle bridge over the island of Štvanice, which will significantly simplify the journey across the Vltava River. SOURCE: IPR PRAGUE

PRIORITY 3

Reducing the intensity of motor vehicle transport (especially in the central areas of the city)

The intensity of motor vehicle transport increases every year. There are parking fees in selected parts of the city, nevertheless motorised transport is almost free of charge within the city territory.

Thanks to incentive measures, like an appropriately set charging system, the volume of motor vehicle transport is gradually Prague is on the way towards sustainable mobility.



Reducing the intensity (performance) of motor vehicle travel within the city is one of the key conditions for the success of fulfilling the aims set out by the Climate Plan. The intensity of motor vehicle travel in Prague is showing a long-term increase, together with rising energy demands and CO₂ emissions produced by transport. Between 2000 and 2010 the performance of motor vehicle travel increased by approximately 36% (from 16.6 to 22.6 million driven km per average working day) and its intensity has increased again by several percent during the last decade (in 2019 it reached values of 23.4 mil. driven km, that is 3.5% more than in 2010).

Without the implementation of additional measures, further development of this type of transport will be largely dictated by the economic situation and social trends - and further demographic changes. As the numbers of inhabitants are expected to keep rising, transport intensity in the reference scenario should follow the same trend, despite being (increasingly) less dynamic.

Prague may alter this “reference scenario of development” by increasing toll fees and increasing its use of public space currently used by cars. Another option is to introduce preconditions for the construction of new high-capacity communications inside the Prague ring road which could result in an increase in the share of individual motor vehicle transport in the transport mix. The requirement would be their inclusion in the Sustainable Mobility Plan “P+” which focuses on assessing projects and their alignment with the city policy; assessment of the construction proposal from the perspective of its wider social costs and benefits should also be included.

Individual motor transport in Prague is currently subject to fees through the Paid Parking Zones (PPZ) for the use of parking in public spaces.¹⁵ These zones now stretch over the majority of the larger city centre (to be exact Prague 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 16, and 22 with some only including them on parts of their territory; Prague 18 is currently preparing for

¹⁵ Paid Parking Zones in the Capital City of Prague - Strategy for the Development of Parking 2020 - 2025. Approved in a decision of the Prague City Council No. 1311 from 26 June 2020 [15].

their implementation). Their current format and use, as well as further development has been approved by the Prague City Council until 2025.

The fee amount is currently charged based on location (delineated into three separate fee zones), whether the parking permit is valid for a year or less, depending on residents, pre-paid, or visitor, whether the registration is for one or more cars or whether the register person is a senior citizen or in possession of ZTP or ZTP-P concession cards. For the time being, electric and hybrid vehicles are For the time being, electric and hybrid vehicles are exempt from the fee, but only if the date of the first authorisation was registered before 30 April 2019, after which it can be extended a maximum of three times. A similar subsidy system will be reintroduced with the expected rapidly growing interest in electric cars (and should be based on lower fees, see [Priority 4 in this chapter](#)).

The primary function of PPZ in public spaces is to regulate so-called static traffic, however it also serves to regulate visitor traffic in highly frequented times. As a term, visitor traffic describes those who travel into the city (for the whole day) for the purposes of work or meetings or those who live in different parts of the city than in which they work.

The concept of fees paid for the opportunity to park in public spaces is seen by the city as a legitimate tool to motivate residents to use more environmentally friendly forms of transport in the city. It is therefore recommended to expand PPZ to other areas of the city and reduce the radius of validity of the

parking permits to discourage owners of resident permits to use cars to travel short distances which would be otherwise reachable through micro mobility. The PPZ development strategy proposes to differentiate parking fees also by the emission class of the vehicle and define a desirable EURO emission class and CO₂ emission level per kilometre according to methodologies used by car manufacturers. However, these reduced fee advantages should only be limited to extremely environmentally friendly types of vehicles.¹⁶ We primarily endorse this advantage for use with long-term permits and for short-term permits only with significant proof from the vehicle owner. For companies, a future requirement could be to purchase "Lítačka" cards and long-term public transport passes in the numbers corresponding to given out parking permits if this

was permitted by the current legislative framework. The parking fee amount should also rise (based on examples of other cities abroad) to a level where it guarantees around 10% of all spaces to remain unoccupied; this will minimise the time and consumption of fuel used to find a possible parking space. This also creates the opportunity to create a fee system based on the current level of demand.¹⁷ The situation should also be improved by introducing a much more effective legal framework for the enforcement of fines (supported by well-structured changes).

Following the above-mentioned strategic documents, the PPZ should be supplemented by a system of fees per kilometre driven in the city, that is a toll, in the first half of the current decade.

The sharp growth of e-commerce platforms and home deliveries is struggling with the capacity limits of the road framework in Prague.

¹⁶ The system of parking fees in Helsinki can be taken as an inspiration. Electric cars and those vehicles which belong to class EURO 6 and also reach pre-set levels of CO₂ emissions per kilometre depending on whether the vehicle is powered by petrol, diesel, or gas engine can save up to 50% (see https://www.hel.fi/helsinki/en/maps-and-transport/parking/vahapaastoisten_alennus).

¹⁷ This system, also called „demand-responsive parking“ has already been introduced in several world cities, the first of which was San Francisco (for more see <https://www.sfmta.com/demand-responsive-parking-pricing> [16])



The future of urban mobility requires a mindset shift towards the multimodal transportation approach. In this approach, mobility is considered a service of transporting a person from one place to another in the shortest possible time. People can use a multitude of multi modal options to reach a destination, using various combinations of different transport services. The route planning functionalities are therefore the key component of the system. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI

Details of how the Prague Toll System (PTS) should be structured were assessed in 2020 in a feasibility study.¹⁸ This study recommended the first step to be to introduce fees for areas of about 10 km² (so-called option 2) which are used by more than 500,000 vehicles. Drawing on experience of toll zones in other European cities the introduction of the selected fee, depending on its amount, could lead to a decrease of 2030% in the intensity of traffic in the area. This could correspond to a daily reduction in vehicles which enter the zone in numbers above 100,000 a day. In an annual overview this could in theory add up (with an average length of travel across the zone being 5 km) to be over 100 million driven kilometres.

In order to prevent the transfer of this traffic to ring roads outside of the toll areas, it will be necessary to extend the areas subject to fees to such an extent that will be economically viable for the city and construct large parking spaces for short-term (single day)

parking. As part of the low carbon strategy of the city it is therefore expected that by 2030, the PTS will be expanded to the size recommended in the study as so-called option 3. Its borders are more or less defined with the basic framework of communications of the inner ring road. The toll zone should therefore be larger than 50 km² and would be used by more than 700,000 vehicles per day. The number of entries into the zone for all types of vehicles during a working day is expected to be more than 220,000, more than 75% of that during times when fees are introduced (7am to 7pm). The volume of realised traffic expressed in kilometres could therefore exceed the higher single digits of millions a day (we are expecting 3-5 mil. km a day). The introduction of toll fees may also be configured to differentiate between vehicle sizes which could motivate residents to use smaller two-seater cars and in turn contribute to less public space being used for motor vehicles. If performance-based toll is

¹⁸ Study for the Introduction of Toll Systems in the Capital City of Prague. Ernst & Young s.r.o. 2020 (not a public document).

to be introduced based on the finalisation of ring roads, it is then possible to conceive of it through a wider (city-wide) lens so that it is able to fulfil a regulatory function for controlling incoming motor vehicle traffic originating outside of the city area. This could also be backed by the need to finance further development, maintenance, and operations of public infrastructure of the city in times where electromobility experiences a significant boost and taxes on the sales of fuels will decline.

A positive side effect of the introduction of PTS will also be a) reduction of emissions of pollutants in the frequented city centre and b) faster, more effective, and more competitive public transport (due to the drop in intensity of individual motor vehicle transport). This will further allow to raise the attractiveness of public transport which will become an even larger part of the lifestyle of Prague's residents and non-residents.

The fees charged for motor vehicle transport should gradually be increased. The impact of toll on motor vehicle transport will be regularly evaluated during the next several years and if price regulation does not result in any positive changes to traffic behaviour, the city will decide whether to adopt a stronger tool in the form of restriction of entry of selected types of vehicles into the city centre in a similar way to other European cities.

A separate category is city logistics (focused on the transport of parcels and cargo for businesses and shops) which builds extensively on lowering the intensity of motor

vehicle transport. The sharp growth of e-commerce platforms and home deliveries is struggling with the capacity limits of the road framework in Prague. The main goal of city logistics should therefore be to reduce the number of kilometres driven by lorries and vans. This can be reached primarily by using self-service parcel boxes which are one of the key tools of new ways of shopping preferred by customers. Parcel boxes are a compromise between shopping in-person in physical stores and home delivery.

Another crucial measure of city logistics connected to a reduction in motor vehicle transport is the operation of city-based depots. Depots based in strategic locations can be used to move parcels from lorries to couriers on foot, or to cargo bicycles. On-foot couriers and cargo bikes can be used to cover the so-called last mile of deliveries and significantly aid in freeing up highly frequented roads in high-density areas of the city, while also eliminating emissions.

Last but not least, incorporating railway and river transport into city logistics is also planned. The largest obstacle for these two modes of transport is scalability, meaning high-cost infrastructure and as a result difficult planning and project implementation. The Prague Methodology for City Logistics works with incorporating both modes of transport into the standard operations of city logistics.



The depot for electric bikes, operating since November 2020 in Prague-Florenc, helps to reduce the number of delivery trucks on streets.

PRIORITY 4

Exchanging conventional fuel vehicles for low and zero emission options

Zero-emission vehicles forms a very small part of the fleet of urban services.

City organizations have modernised their fleets with battery powered or hydrogen powered vehicles. In public transport, trolley buses partially replaced conventional buses. Along with development of electromobility, a dense network of charging stations is built in the city.

The fourth key priority for Prague in keeping to its climate pledge in the transport sector is to consistently and as much as possible increase the use of such vehicles that utilise low and zero emission fuels and are capable of operating with minimal or zero pollutant emissions, including CO₂.

It will be necessary to introduce this objective first with those vehicles, which rank the highest in the number of kilometres driven every year, in this case primarily public transport buses and waste removal and street cleaning service vehicles. This should be closely followed by light vehicles such as those operating transport services, individual transport in the form of cars and other vehicles - including boats used for personal transport in Prague or vehicles used in construction.

These efforts will be vastly improved with the help of strict regulations imposed on car manufacturers in the European market.¹⁹ As a result of these, the European Union has begun the process of mass transfer to electromobility, first with new cars and lat-

er also with lorries and buses, which will result in a much broader range of choice of electrified models for prices which will drop down much closer to those of conventional fuels.

In addition, starting from 2 August 2021, EU regulations²⁰ will require public contracting entities as well as contractors in individual fields/sectors to demand a ratio of "clean vehicles" (see [box on p. 80](#)). The requirements for their compulsory inclusion will be applied during purchases or leasing of new vehicles of almost all categories (cars, light cargo use, or even lorries and buses), as well as during the purchases of services which have are related to either providing or using other transport services (e.g., waste collection, postal services, parcel transport).

As the future development of this sector has already set and its importance is expected to rise - dynamically - every year, it is crucial to set a goal for 2030 which would aim to reach at least 30% of all motor vehicle transport to be realised using low and zero emission fuels.

¹⁹ This relates to two regulations imposed by the European Parliament and Councils Regulation (EU) No. 2019/631 for new passenger cars and light commercial vehicles (vans) [18] and Regulation (EU) No. 2019/1242 for heavy duty vehicles [19].

²⁰ Directive of the European Parliament and Council (EU) 2019/1161 published 20 June 2019, amending Directive 2009/33/EC in the promotion of clean and energy-efficient road transport vehicles. [17]



Hybrid buses, electric buses, battery trolleybuses or classic trolleybuses are the future of Prague's public transport. PHOTO: DPP

The fulfilment of these conditions would necessitate significant changes to the fleet of municipal vehicles and Prague intends to set an example in this direction.

The main focus of the transformation of the city's and city organisations' fleet towards the use of cleaner vehicles will be Dopravní podnik hl. m. Prahy (DPP; Prague Public Transit Company) which currently uses approx. 1,200 **buses with an overall distance covered annually reaching up to 65 million km.**

Due to the efforts of DPP to keep the average age of their vehicles under 10 years, the entire fleet will practically be renewed during the next decade. Because it is a public contracting entity, the company will be required between 2021 and 2025 to include in their purchases at least 41% of "clean" buses and in purchases during the 2026 to 2030 period, this percentage will have to rise to 60%. In absolute terms, this will be the purchase of roughly 600 buses fulfilling the criteria for "clean vehicle" which the DPP will purchase for 2021-2030. At least half of all newly purchased buses should therefore be zero emission.

DPP currently has a concept of steps which will aid in realising the goals set for 2030.²¹ The Strategy anticipates gradual acquisition of vehicles with electric engines capable of charging in depots, as well as during travel with the goal to electrify 12 lines in total and approximately 120 buses by 2024 and by 2030 expand this electrification process to bus lines on the east bus tangent and lines terminating in the Smíchov station terminal. DPP will also make efforts to implement zero emission operations on its city centre lines.

The climate pledge, however, requires stricter political decisions concerning the adoption of much higher expectations on the extent of replacement of diesel buses with zero emission vehicles than given

by the Directive (EU) 2019/1161, article 5, paragraph 1 on promotion of clean and energy-efficient road transport vehicles.²²

It is proposed to utilise the maximum potential of co-financing from European programmes and the Modernisation fund for the proposed renewal of the DPP bus fleet and set a goal of 75% battery powered electric buses and trolleybuses, or hydrogen powered vehicles by 2030 for the entire company fleet. A similar share should be required by the ROPID company towards other carriers who supply the city with public bus transport tied to public services. Aside from investment grants, the higher savings from the purchases of fuels should also aid in covering the initial investment costs.

It is possible to expect that the price of buses purely powered by electric power will become more accessible in the horizon of 2025 due to the significantly rising demand for such technologies and technological advancement. An electric bus will therefore become the most profitable in comparing investment costs and its life cycle. For this reason, DPP should initiate the purchase of buses powered solely by electricity (in versions which will be optimal for their use and respecting their necessary capacity) starting from 2026, which marks the year for the new quota of 60% prescribed by the EU Directive, as well as begin the purchases of hydrogen powered buses.

It is necessary to apply similar ambitions to purchases of vehicles for the public service of passenger transport on city and suburban lines of Pražská integrovaná doprava (PID; Prague Integrated Transport), which are supplied by the ROPID city company and are operated by other carriers. It is therefore necessary to require the highest levels of compliance of other carriers with introducing zero emissions buses.

Another major city organisation which operates a substantial vehicle fleet is Pražské služby, a.s. (PSAS; Prague Services). The advantage of this particular organisation is that it already possesses alternative fuel vehicles in its fleet, more precisely, vehicles fuelled by compressed natural gas (currently almost 130 ve-

hicles, representing approximately 15% of all vehicles operated by the company). It is desirable to continue in such positive steps forward, including that starting at a set date (2. August 2021) the company's internal guidelines which state that only vehicles complying with the definition of a "clean vehicle" as defined by the above-mentioned Directive will be adopted by the company's executives.

Additionally, due to the city's aim to collect separated biodegradable waste for the production of biomethane, that is, an advanced biofuel with the potential use in replacement of natural gas, in amounts corresponding to annual production of 3 to 5 mil. m³, the PSAS fleet may expand several times larger (approximately 2-3 times, meaning up to 300 vehicles more) and still stay neutral in its production of CO₂. As technological advancement will bring affordable and competitive models of electric "KUKA" cars in the next couple of years, intended for waste collection or cleaning purposes, it is possible to say that the remaining part of the fleet (about 450 vehicles) will also be replaced with zero emission cars represented by hybrid or fully electric models by 2030. As a result, by 2030 at least 75% of the PSAS fleet's energy consumption will be replaced by bio-CNG produced in a biogas station processing biodegradable general waste or be powered primarily by electricity produced in cogeneration at ZEVO Malešice.

The same steps should then be repeated for other providers of larger numbers of vehicles within the city's territory, who should be contacted appropriately. The above-mentioned standards should further be included in conditions included in public procurement for the city and city organisations for those contracts which directly or indirectly involve employing vehicles within the city and road framework on its territory. These are mostly construction companies, where these conditions can be expanded to involve construction vehicles. In other countries, the dominant use of electricity as the main fuel in construction is becoming increasingly common in densely populated cities. It is possible to electrify passenger boat transport in similar ways in the

²¹ Proposal for the Use of Alternate Fuels within the Prague Transit Company. Prague. 9/2020. [20]

²² This condition will understandably not apply in 2021 to the already agreed purchase of diesel buses by DPP which was made under a currently ending long-term supply contract.

Summary of new legislative requirements for the purchase of new road transport vehicles for public and private sector procurement, entering into force in 2021

The new Directive (EU) 2019/1161 introduces from 2 August 2021 a requirement for public contracting authorities and those in selected other sectors (so-called “sectoral contracting authorities”) to demand a certain percentage of clean purchased vehicles or transport services to be operated by such.

The definition of a clean vehicle is differentiated based on its category and in the case of category M1 (passenger cars), M2 (smaller buses under 5 t) and N1 (light commercial vehicles) and whether it was purchased before 2025 or in the period after.

Smaller vehicle categories (M1, M2, N1) should be defined by CO₂ emission

limits at 50 g/km until 2025, starting from 2026 the limit will shift to zero grams of CO₂ per kilometre.

For buses (category M3) and heavy duty vehicles (category N2 and N3) a clean vehicle is defined differently, but again in two levels. It may be a car with a combustion engine using alternative fuels or an electric vehicle, alternatively in combination with a combustion engine capable of reaching pre-defined CO₂ values of 1 g/km or g/kWh (so-called zero emission heavy duty vehicles) in a mandatory test. Hydrogen, advanced biofuels, natural gas (liquefied or compressed) and LPG are considered to be among alternative fuels.

The minimum ratio of shares of clean vehicles for the Czech Republic were set as follows:

- Vehicles of smaller categories (M1, M2, and N1) for 2021–2025 min. 29.7%, for 2026–2030 min. 29.7%
- Buses (M3) for 2021–2025 min. 41%, for 2026–2030 min. 60%
- Heavy duty vehicles (N2 and N3) for 2021–2025 min. 9% and for 2026–2030 min. 11%

To reach the set ratio of buses and heavy duty vehicles, it is necessary to utilise at least 50% of vehicles of the second category, that is zero emission heavy duty vehicle.

future. However, this will require investments on behalf of the boat owners. The city could provide incentive for these steps through modification of conditions for boat mooring on the waterfronts.

The development of clean vehicles in motor vehicles with zero (exhaust) emissions will have to be simultaneously supported by expanding public and private charging infrastructure.

The advent of electromobility is expected to be relatively fast – as car manufacturers are forced to lower the average CO₂ levels in production lines. According to various analyses, there is a high probability that in 2030, 40-50% of all newly registered passenger cars (and possibly cars of other categories) will be manufactured as battery powered electric vehicles or a fully (or plug-in) hybrid car combining electricity with a combustion fuel engine. A development breakthrough in fuel cells is also possible, while it is more likely to be used more for heavy weight vehicles and buses.

Although the numbers of new vehicle registrations in Prague are currently above 100,000 a year, as stated by statistics provided by the Ministry of Transport²³ (in 2017 to 2019 the average was approximately 120,000), continuing at the same speed, between 2021 and 2030 more than 1 mil. vehicles will be registered. It is not possible to state how many of them will be electrified (battery or hybrid), however it is highly likely to be between 100,000–200,000, considering that the middle range value of this estimate is approximately 150,000 vehicles.

However, their inclusion in the flow of traffic will be higher, as it is possible to expect a significant number of electric car journeys being used for transport to place of work or other work-related tasks from Prague’s vicinity, as well as other locations much further (undertaken using company cars).

For this reason, it is important to prepare the city for such an extent of electrified transport and its implications relating to charging networks.

The issue of **charging stations** is problematic on several levels. First owners of electric cars are now those individuals and organisations, who possess the opportunity to charge their vehicles at home or at their workplace. The process of installing charging stations is the least technically and economically demanding in such places, as they become a part of a pre-existing supply point. However, with the increasing numbers and frequency of such charging spots of this (non-public) character, it will be necessary to introduce remote management of availability of electricity from the distribution network on behalf of the provider. This will necessitate installations of smart electrometers and charging stations capable of automatic regulation of charging power depending on the local demand in the supply network. It is possible to estimate that the first couple of thousands of electric vehicles could be charged using these methods (that is, from private charging stations capable of being controlled remotely).

For a significant development in electromobility, charging infrastructure will need to be expanded into publicly accessible spaces. According to the Ministry of Industry and Trade, more than 60 such hubs were installed in Prague by late 2019. The expected numbers which will become necessary are, however, in tens of thousands.

Realistically, the spaces which seem the most suitable for their installation are publicly accessible garages (both above- and under- ground) and P+R car parks which currently comprise more than 10 to 15 thousand parking spaces in Prague. Other thousands of public parking spaces are in car parks in residential housing blocks, shopping malls, and institutions. If electric cars are to become a purchase which is made by those who do not possess access to private land where they can install a charging station, these are all places where such infrastructure will become necessary.

Prague should initiate the construction of publicly accessible charging spots in city garages, P+R parking near highly frequented places for sport, culture, and other activities, while also defining regulations which



Public charging infrastructure will take a variety of forms. It can even serve as a source of energy. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI

are to be maintained if charging stations are to be built and operated by other actors.

In this way, Prague can unify their visual identity, set payment systems, and influence the price of electricity for charging purposes. This is mainly due to the fact that it is possible to use support from current grant programmes for the purposes of installing charging stations (which would lower the initial construction costs, following write-offs, and returns from the initial invested capital). Cities which are the most successful at electromobility even temporarily do not charge their customers for electricity. With significant co-financing of the initial price of the charging stations (the OPD programme supports up to 70%), it is possible to lower the costs of electricity sold way below 5 CZK/kWh incl. VAT and therefore make the operations of electric cars in Prague much cheaper. It will further be possible to influence the city’s active role in the creation of charging infrastructure by choosing the sources to supply electric power (as much as possible this should be electricity from plants using fuel other than coal).

The expected optimal outcome by 2025 is to have 5,000 to 10,000 publicly accessible stations within the

²³ <https://www.mdcr.cz/Statistiky/Silnicni-doprava/Centralni-registr-vozidel> [21]



The power supplier PRE is the leading developer of Prague's charging infrastructure, which partially uses the network of transformer stations. PHOTO: PRE, A.S.

city area and increase their numbers according to further development and demand (it is recommended to keep a ratio of 10–15 electric cars per one station). The city should similarly ensure the appropriate conditions for construction of charging infrastructure that will allow possible electrification of passenger boat transport on the Moldau river (by building dozens of charging stations near waterfronts).

It is important to coordinate the development of charging infrastructure with the manager of the distribution network and systematically introduce elements of smart networks – this is the only way in which it is possible to imagine that Prague's distribution network will be able to serve such large numbers of cars and other vehicles.

Even city mobility expects the transformation of cargo vehicles into low and zero emission standards. Despite steps such as self-service parcel boxes, or city logistics depots, a large amount of parcels and goods will remain to be delivered by lorries or heavy-duty vehicles. It is a positive sign that a number of logistics companies are already planning to reduce their emissions due to social responsibility pressures and cus-

tomers' preferences. These companies will serve as an example for others who will slowly follow – be it from their own interest or through external pressure to purchase low and zero emission lorries and heavy-duty transport vehicles. It is important to also include supply cars while developing the charging infrastructure.

It would also be beneficial for the city to play a larger role in coordinating the ways of supplying the city with necessary goods and services (the city can aid with the development of so-called "light and electric city logistics", meaning the use of light duty electric vans and similar modes of transport using electricity and possibly being capable of autonomous driving).

Prague and city organisations should also actively work on developing charging hubs (places which group 5–10–15 charging stations of different outputs; ideally, 5–10 of such places should be established together with pilot projects demonstrating the opportunities of hydrogen mobility).

The first hydrogen refuelling station in Prague is to be constructed in 2021, and due to future supporting programmes, it will be possible to finalise several others by 2030. A demand for hydrogen is likely to rise

How to extend zero emission bus transport to PID lines

A good opportunity to expand both zero emission bus transport and extend it into PID operated lines could be the construction of the Smíchov station terminal in a way that it may integrate the necessary charging infrastructure for a higher capacity of electric buses.

The terminal is currently operating as the end station of suburban lines from the south and southwest of Prague and its establishment could therefore be a way of transforming these lines into ones operated by electric buses.

Electrification could firstly be implemented on lines going through D4 in the direction of Jíloviště, Mníšek pod Brdy and Příbram (317, 318, 320, 321, 392, 393 and 395). They could be conceptualised as partial trolleybuses, that is, equipped with a battery powered distance extender, which are capable of being powered solely by a battery for up to 10 kilometres and then repeatedly charge during travel.

A possible charging segment could be the hill rise towards Cukrák which ex-



The planned transport node Praha-Smíchov is considered an important investment into charging infrastructure for electric buses. SOURCE: IPR PRAHA

tends for several hundred metres and the use of overhead wires could aid the buses in climbing the hill. Further charging would be necessary to include in another suitable portion of the track.

The construction of the new Smíchov transport node should begin in

2022–2023 and see completion around 2026. Trolleybus overhead wires could then be utilised for other additional similarly electrified vehicles (e.g. lorries used for deliveries and transport of goods).

for heavy duty vehicles employed for longer distances, as well as trains which are currently used on non-electrified tracks. Prague can contribute to the advent of hydrogen mobility by initiating pilot projects including the construction of appropriate infrastructure and purchase of transport vehicles.

One of the main barriers for purchases of zero emission vehicles is the lack of experience connected to their use and operations. It seems apt to demonstrate their operational parameters, at least on a smaller scale, through new transport services – particularly systems of car and other vehicle sharing (e.g., passenger cars, light commercial vehicles, motorcycles, electric bikes, scooters, etc.) and on demand transport or mobility-as-a-service.

These new forms of passenger transport have the potential to contribute to lower the intensity of conventional individual motor vehicle transport (using conventional fuels). However, a key condition for this is their integration into the current public transport system in ways that will ensure they are complementary rather than competing with current public transport vehicles (e.g., by being able to use the Lítačka card for such services without the need for further registration, by including them in route planning in travel apps, and by making them available in places, where it is not currently easy or possible to introduce public transport due to costs).

PRIORITY 5

Supporting the transformation of air transport towards sustainability



In the last decade, the Prague Airport recorded an increase of passengers and currently it is preparing further development to strengthen its position as a major transport hub in Central Europe.

Air travel in Prague reduces CO₂ emissions by 15% in comparison to the year 2010. Offering favourable fees for carriers using aircrafts with low carbon foot may change travellers preferences. In a broader context, it is important that the airport has a new direct railway connection to the center of Prague.

Air travel is widely considered to be one of the most difficult branches of transport to undertake the move of gradual decarbonisation. Its role in the baseline carbon footprint of the city is not very prominent and reaches below 2% (approx. 135,000 tonnes). However, this represents only a fraction of the overall emission related to air travel due to the currently used methodology of evaluation.²⁴

This year's steep decline of air travel due to well-known circumstances demonstrates, however, how quickly well-established habits can change.

Prague sees this situation as an opportunity for a significant change - it is conceivable that through a combination of suitable measures, air travel could develop further through sustainable ways going forward. Sustainability is here defined as a gradual implementation of such measures which will allow for transport of passengers with much lower carbon

footprint than before. In the 2030-2035 horizon, it is already possible to anticipate that carriers will introduce solely battery powered aircrafts to the market for short-distance flight routes.

For aircrafts travelling longer distances, the appropriate solution will be the use of synthetic fuels produced from renewable sources, and perhaps even the introduction of hydrogen. At the same time, manufacturers will also improve the effectiveness of newly produced aircrafts which should reflect in lower use of fuel calculated per passenger or cargo. Prague can support this trend by establishing close cooperation with Prague Airport, for example by offering favourable fees for carriers using such aircrafts or provide various incentives for travellers which use their services.

The issues of air travel transformation towards more sustainability is the responsibility of the state

²⁴ Only emissions produced in the so-called LTO regime (landing and take-off) are counted. That is, the emission calculated originating from the journey of the aircraft from the terminal to the runway and from the initial flight of up to 915 m (and, conversely, the emission produced after landing and parking at the terminal gate).

or Prague Airport. It is therefore not possible to influence these actors without their positive approach and permission.

Short distance flights may, of course, be reduced and replaced with railway travel - more specifically, with high-speed rail networks.

The transformation of air travel towards ecological sustainability is currently also a condition put forward by certain European countries when providing assistance loans during the ongoing crisis, and the emphasis on such is to become stronger as airlines become involved in emission trading. The conservative goal which the Climate Plan sets for air travel in Prague is to reduce CO₂ emissions before 2030 by 15% in comparison to the situation in 2010.

Achieving this goal - in light of the global situation - will be significantly influenced by the future development of air travel. By the end of the last dec-

ade, Prague Airport recorded a rising trend in the number of passengers per individual flight (in 2010, approximately 11.6 million passengers were transported at an approximately 156,000 aircrafts while in 2019 it was 17.7 million passengers per the same number of aircrafts) and the volume of air travel has historically almost doubled every 15 years. It would now seem that the continuation of the same trend is improbable (which is further underlined by the discontinuation of high-capacity aircrafts represented primarily by Airbus A380).

As no strategic document of the capital city has given more detailed attention to air travel, its inclusion in the Climate Plan is a first step towards the beginning of a working relationship with the main stakeholders, primarily Prague Airport and its shareholders.



Visualisation of the future public space of Václav Havel Airport Prague. SOURCE: PRAGUE AIRPORT



By 2030, the new railway connecting the airport with the center of Prague and with the city of Kladno is planned to be finished. SOURCE: SPRÁVA ŽELEZNIC

HOW TO MEET THE GOALS

List of proposed measures

- 1 **Realise the construction of metro line D.** Along with other investments, this would increase the numbers of transported passengers by 20-25%, that is approximately 100 mil. passengers a year, and because of this it will replace individual motor vehicle and bus transport in the southern area of the city.
- 2 **Automate metro line C.** As a highly innovative project, the automation of metro line C is closely tied to the construction of line D. Costs for line C are expected to exceed 15 billion CZK. Its benefit will be higher transport yields in peak times, as well as a sharp reduction in costs related to daily operations.
- 3 **Ensure the replacement of railway carriages in the suburban rail network with larger capacity options** (and implement further measures which will allow for a continuous increase in the effectiveness of traffic); investment costs expended by the transport service provider (and reflected in the subsidy paid from the capital city's budget). The aim is to maintain the increase of passengers transported on PID trains in Prague and reach up to 230,000 transported passengers daily by 2030.
- 4 **Support the construction of all upcoming major railway infrastructure in the city**, including the electrification of at least some of the remaining lines, with the aim of accelerating their initial phase for early implementation, preferably before 2030. Focus should be placed on modernisation of the railway line to Kladno (with the possibility of transforming the existing line into a new core bicycle path).
- 5 **Extend paid parking zones to other parts of the city and in due course include a fee system (toll system).** It is possible to set the fee charge amount depending on current demand.
- 6 **Continue in implementing preferential measures for public transport** which are key for reliability, travel speed, attractiveness, and energy efficiency, as well as renewal of current infrastructure.
- 7 **Implement the construction of new tramway lines** following the Strategy on the Development of Tramway Lines in Prague.
- 8 **Build new and expand existing cycling paths** with the aim of gradually separating them from other modes of transport; at the same time implement other measures to reduce barriers to the development of cycling and walking in the city.
- 9 **Beginning at a set date (august 2021) purchase solely buses which are entirely zero emission or hybrid powered;** similarly enforce the same standards for other city vehicles and companies which provide any type of transport services for the city.
- 10 **Advocate for the construction of at least 10,000 publicly accessible charging stations in the city; primarily in publicly accessible garages, P+R car parks, parking near frequently visited buildings, on the waterfront for possible use by boats, etc.**

- 11 **Develop innovative transport services such as carsharing, transport-on-demand and mobility-as-a-service** using zero emission modes of transport and integrate them appropriately into the city-wide public transport system (through multimodal journey planning tools, unified registration and payment using the Lítačka card).

- 12 **Organisation of a long-term information campaign on the advantages and benefits of sustainable (especially public) transport**, aiming to raise awareness of its first-rate qualities in Prague and targeting an increase in its popularity. Transport can also be used to demonstrate other activities and areas of the Climate Plan.

The modernization of the railway corridor between Prague's main railway station and the Hostivař district will enable greater involvement of trains in urban public transport. For this purpose, a new railway station Praha-Zahradní Město was opened in September 2021. PHOTO: METROSTAV, A.S.



The modernization of the southern railway corridor also includes the reconstruction of the Praha-Vršovice railway station. SOURCE: SPRÁVA ŽELEZNIC

Circular Economy

In the field of waste management, Prague sets an ambitious goal to **lower the amount of produced general waste by half** before 2030 and **increase the recycling of household and traders to 65%**.

CORE PRIORITIES

Effectively prevent the production of household waste and waste across sectors

The best waste is the one that will not be generated. To make this happen, Prague must intensify its current activities in this area.

→ [p. 92](#)

Sort, recycle, and reuse the maximum percentage of waste, if possible, near its place of origin

In order to meet the commitments of the Prague Climate Plan 2030, the city must increase the ratio of sorted response by more than twice in 10 years.

→ [p. 95](#)

Effectively recycling and reusing sorted secondary raw materials

New technologies will allow finer sorting and better use of sorted materials.

→ [p. 98](#)

Introduce principles of circular economy into the building and demolition sector

The greatest potential for waste reduction is to change the rules for new construction.

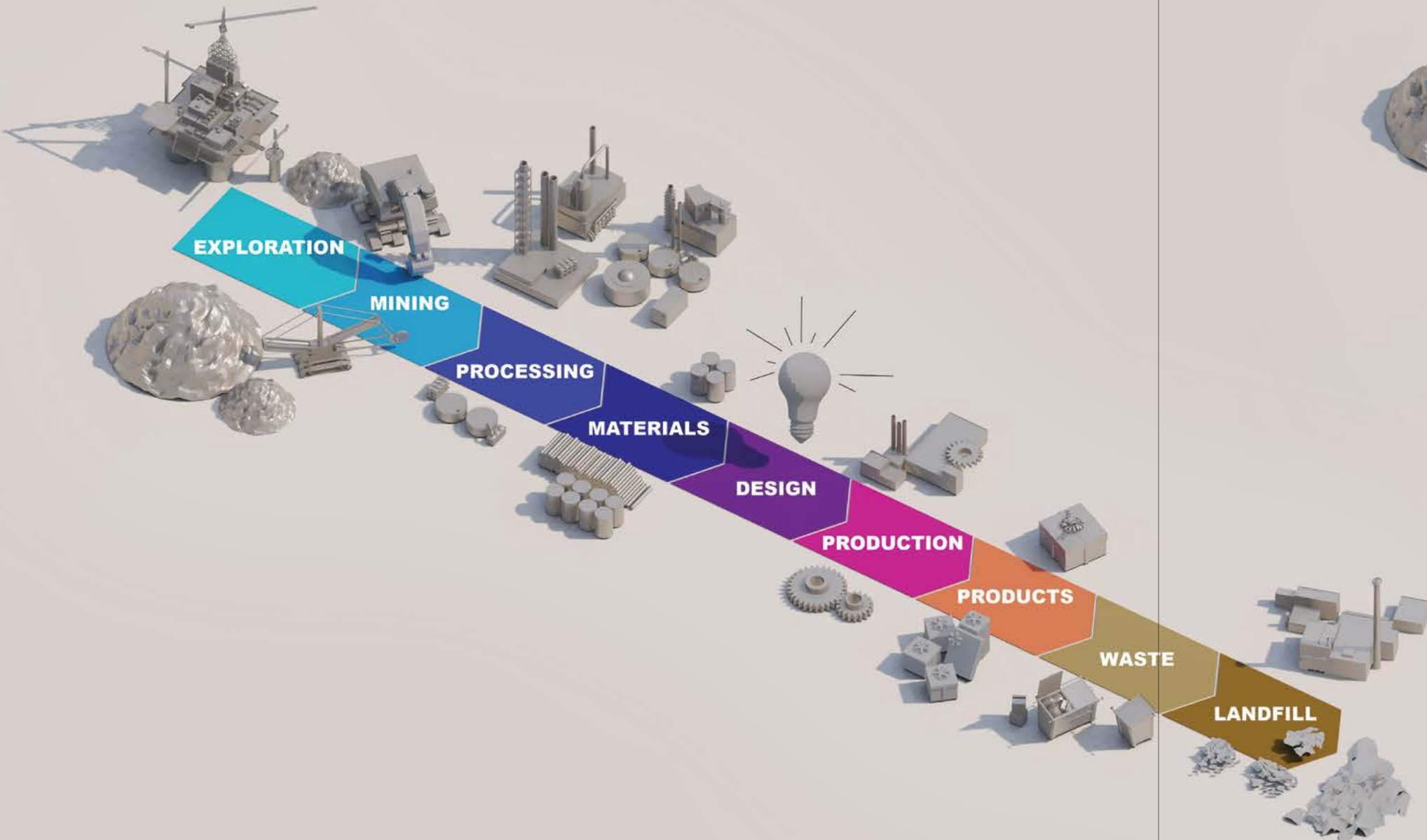
→ [p. 100](#)

Make efforts to cooperate with ministries and other sections of government administration, industry, experts, and the public

→ [p. 102](#)

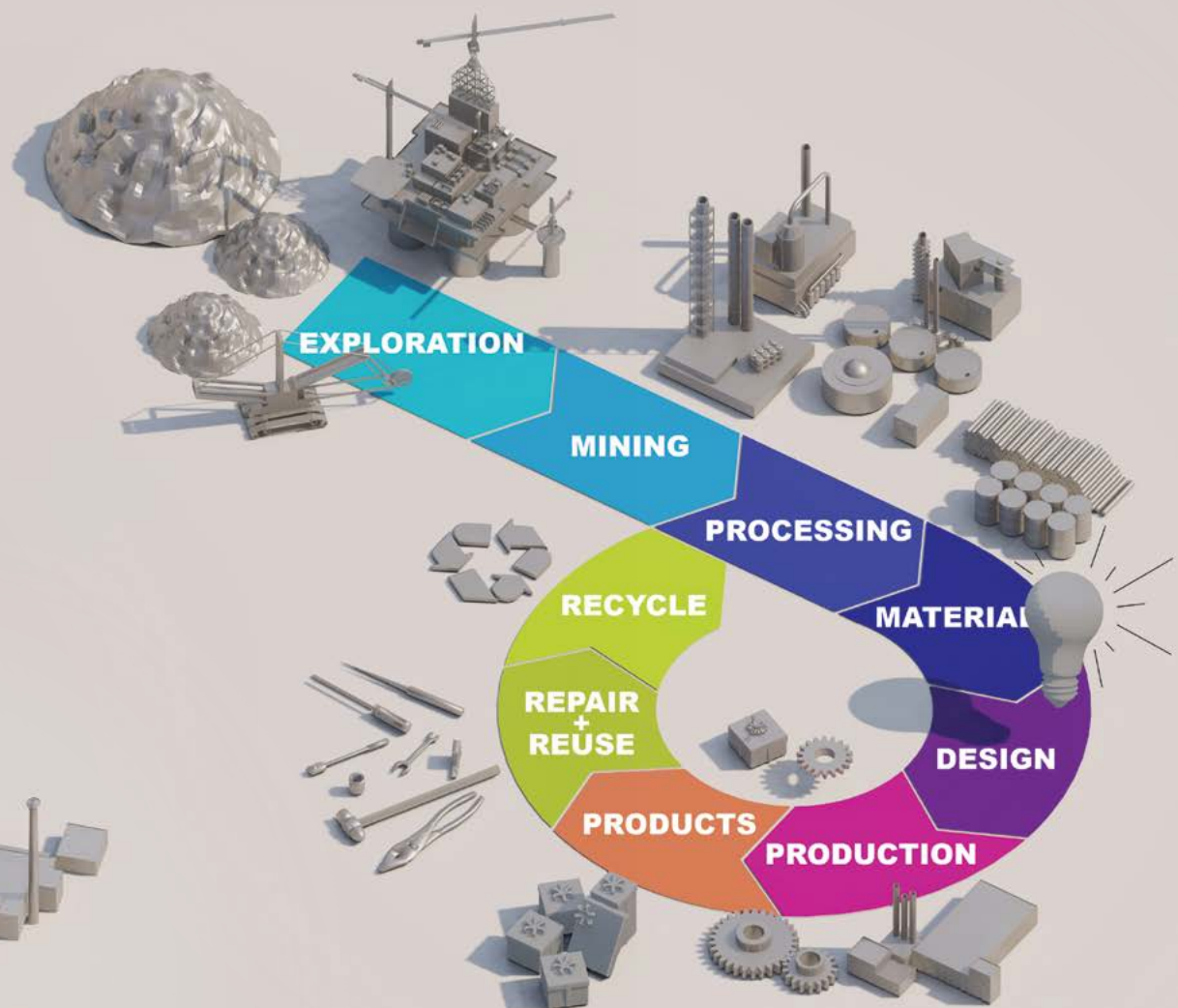
The standard model of linear economy

The path of materials in this model is straightforward from **raw materials** to **production**, then to **distribution** and via **consumption** to **waste**.



The sustainable model of circular economy

The basic idea of the circular economy is: waste is a raw material. This allows efficient material circulation from **raw materials** through their careful **design** (to make them as recyclable as possible), **production**, **distribution**, and **consumption** to **collection** and **recycling**. Only a small part of the waste remains unused.



PRIORITY 1

Effectively prevent the production of household waste and waste across sectors



With 27%, the total ratio of recycling in Prague is far below the national average. The general waste production is around 440 kt/year.

Systematic support for activities enabling the use of things that would otherwise end up in the bin has helped to stop the growth of waste production. Prague is reusing more and more waste.

Total production of waste in Prague reached approx. 5,187 kt in 2018. The largest segment was recorded as originating from building and demolition works within the city area.

Further processing of general (household) waste is a responsibility of the city. An outline of primary goals for waste management will be defined in the Prague Waste Management Plan.²⁵

In 2019, a total amount of 120 kt of usable materials were recovered from the overall 441 kt of general waste produced. Material recovery (recycling) represented 27% of all general household waste. Legislation currently underway will allow for utilising metals and paper from waste buy-out facilities. As an example, more than 55 kt of paper, which is not otherwise counted into the numbers of recycling in Prague were submitted to these fa-

cilities. Almost three quarters of all general waste are used in energy production (289 kt) or were disposed of in landfill (64 kt).²⁶

On the other hand, the amounts of general waste produced have been steadily increasing with every passing year. In the past six years only (2013-2019) their production rose by 10%. The total ratio of recycling in Prague (27%) is currently much lower than the national average (41%).²⁷ This is despite new legislation setting a nationwide requirement to recycle around 60% of all waste in 2030 and up to 65% in 2035 and sort general waste on a city or town level at 60% in 2025, 65% in 2030 and 70% in 2035.

The baseline hierarchy of waste management will be defined by European legislation and it is possible to define its main output as prevention of the production of waste.

²⁵ Prague Waste Management Plan http://portalzp.praha.eu/public/a6/a6/cb/2163511_651253_POH_krajPraha_2016_final.pdf [22]
²⁶ Overview of production and management of waste in the Capital City of Prague [23] http://portalzp.praha.eu/jnp/cz/odpady/souhrne_informace/index.html
²⁷ https://www.mzp.cz/cz/news_20201124-odpadova-data-2019-Kazdy-Cech-vyprodukoval-551-tun-ko-munalu [24]

FIGURE 13 Effectively preventing the production of household waste and waste across sectors

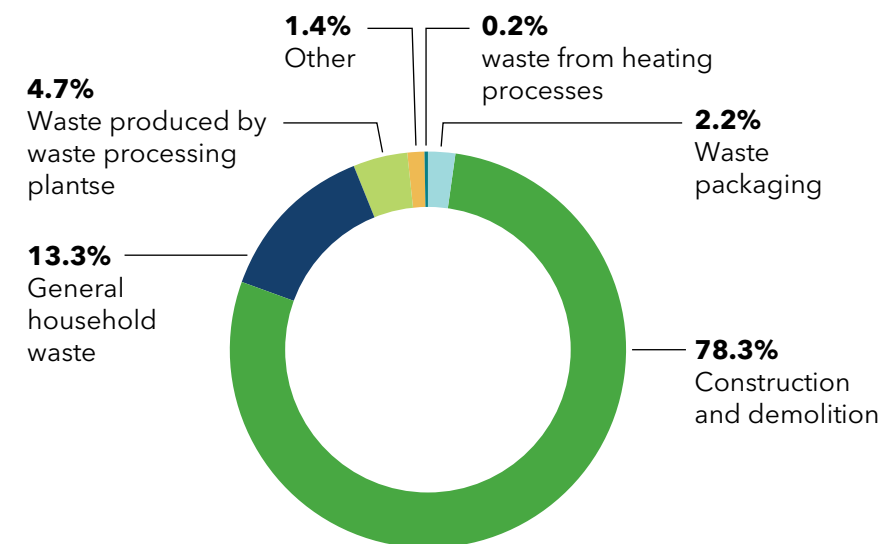
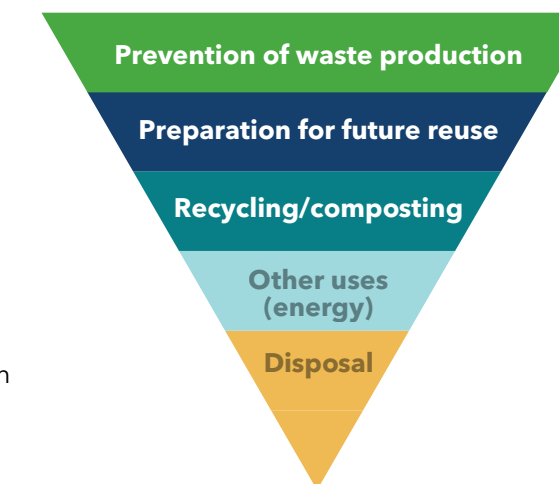


FIGURE 14 Hierarchy of waste management



Prague's circular strategy 2030

Following the examples of other European cities, the Prague City Council issued the preparation of the circular economy strategy, the aim of which is to search for systematic measures and solutions for the transition of the city to a circular economy, as well as preventing unnecessary losses of raw materials and energy in economic activity - for example in construction, production of foodstuffs, forest and land administration, water sources, and consumer goods or waste management.

Utilising all reuse opportunities could bring up to 2.5-5% reduction of the total CO₂ emissions.²⁸

A second life for furniture and other products

One of the ways through which we can effectively prevent the production of waste is to support repairs and exchanges of furniture. The majority of furniture in waste collection points may be reused.

Prague has currently made the option available for collection of unwanted but still usable goods at two

waste collection centres (RE-USE points). Such functional goods are offered primarily to non-profit organisations and social cooperatives via an online-based platform "Nevyhazujto.cz" (freely translated as Donot-waste.cz).²⁹

Prague will continue to support projects which allow for easier repairs of products, organisation of events focused on exchange of used clothing (swaps) or the establishment of permanent RE-USE points and centres where customers may purchase functional second-hand goods.

Regulations for public procurement, subsidies, and property management

Large amounts of waste can be avoided by supporting home composting and ecological agriculture in Prague. Household and community composting are the best way to utilise organic waste and transform it into valuable organic fertiliser. Aside from support for the construction of a high-capacity composting

²⁸ <https://www.c40.org/researches/municipality-led-circular-economy> [25]
²⁹ www.nevyhazujto.cz [26]

RE-USE points at two collection centres in Prague

Furniture, toys, bicycles, tableware, books... Are you sure you don't want them anymore? Nobody around you is interested and selling them would be a hassle? Throwing things away would be a pity and they can still make someone else happy.

Give your unwanted belongings another chance! Take them to selected waste collection centres with a RE-USE point. They will take your things, photograph them and in turn offer them to those in need. Such as homeless shelters...

Waste collection centres

(see <https://reuse.praha.eu>):

- Zakrytá, Praha 4-Záběhlice
- Pod Šancemi 444/1, Praha 9-Vysočany



PHOTO: MEDIA-LIST S.R.O.

PHOTO: MEDIA-LIST S.R.O.

facility in Horní Lada, Prague has a long history of supporting these activities.

The best type of waste is that which is never produced in the first place. The most problematic categories of waste, from the perspective of amount and further recycling, are plastic products and single use packaging. As a result, Prague adopted³⁰ regulations which will limit the use of single use plastic packaging and products within the Prague City Hall. This is intended to gradually apply to **responsible public procurement** in other fields.



Organizing swap events is an effective way to reduce the amount of unnecessarily discarded clothing.

³⁰ <https://www.c40.org/researches/municipality-led-circular-economy> [25]

Support of household composting in Prague

In September 2018, first interested parties signed contracts with the city to be assigned a garden compost bin. During this project in support of household composting Prague made available 1,750 composting bins.



PHOTO: JAKUB CIGLER ARCHITEKT

PRIORITY 2

Sorting, recycling, and reusing the maximum percentage of waste

Biological waste that forms up to 40% of household waste is still used only in minimal quantities.

Prague has a modern biogas station which allows to use sorted biodegradable waste for biomethane production. The newly produced biomethane is not only used for energy, but also introduced into the gas distribution infrastructure.



Separate collection of organic household waste

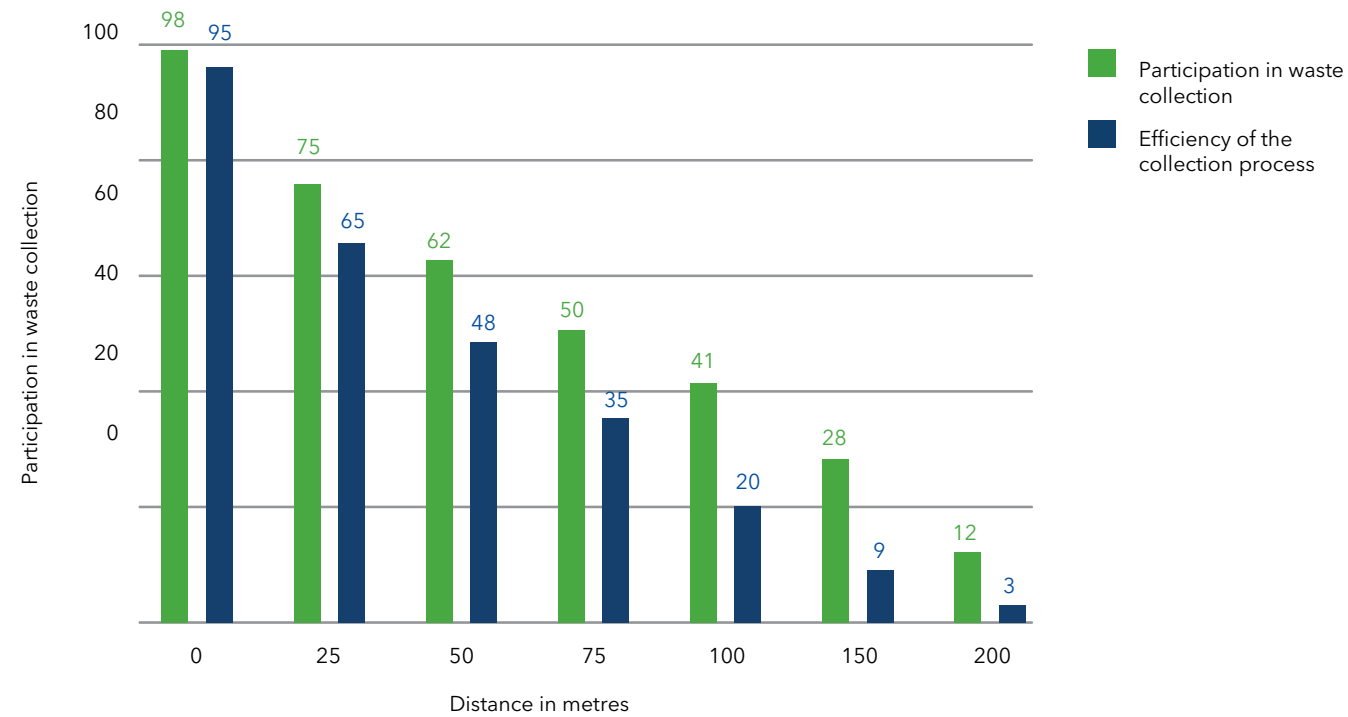
More than 40% of all general waste collected constitutes biological waste. **Prague has made the collection of plant-based bio-waste easier and is expanding the capacity of its composting facilities** (Slivenec, Ctěnice, and the awaited Horní Lada). A ma-

major change will be brought about by the production of biogas from **household and restaurant food waste**.

An extension of the currently underway pilot project of collection of kitchen scraps³¹ and their sorting in city districts 5, 6, and 7 is also planned with a possibility to add coverage for the whole city area.

³¹ See Prague City Hall press release: http://portalzp.praha.eu/jnp/cz/tiskove_zpravy_z_mesta/praha_spusti-la_pilotni_projekt_svozu.html [30]

FIGURE 15 Impact of distance on the level of recycling



The processing of sorted bio-waste will be undertaken in a **biogas station** (one of the options is to install such a facility in the complex of Pražské služby, a.s. in Malešice or in another location).

Around 50,000 tonnes of collected biodegradable waste can yield approximately **3 million m³ of biomethane a year** which will then be pressurised and pumped into the natural gas infrastructure. The waste produced by biogas stations - digestate - may be used as an organic fertiliser after adequate treatment.

Biomethane from waste water treatment sludges is also produced by the **Prague Central Water Treatment Plant** (Ústřední čistírna odpadních vod Praha). After the finalisation of an **intensification project, the increasing of its capacity and introducing more effective technologies, the production of biomethane is likely to rise.** The newly produced biomethane

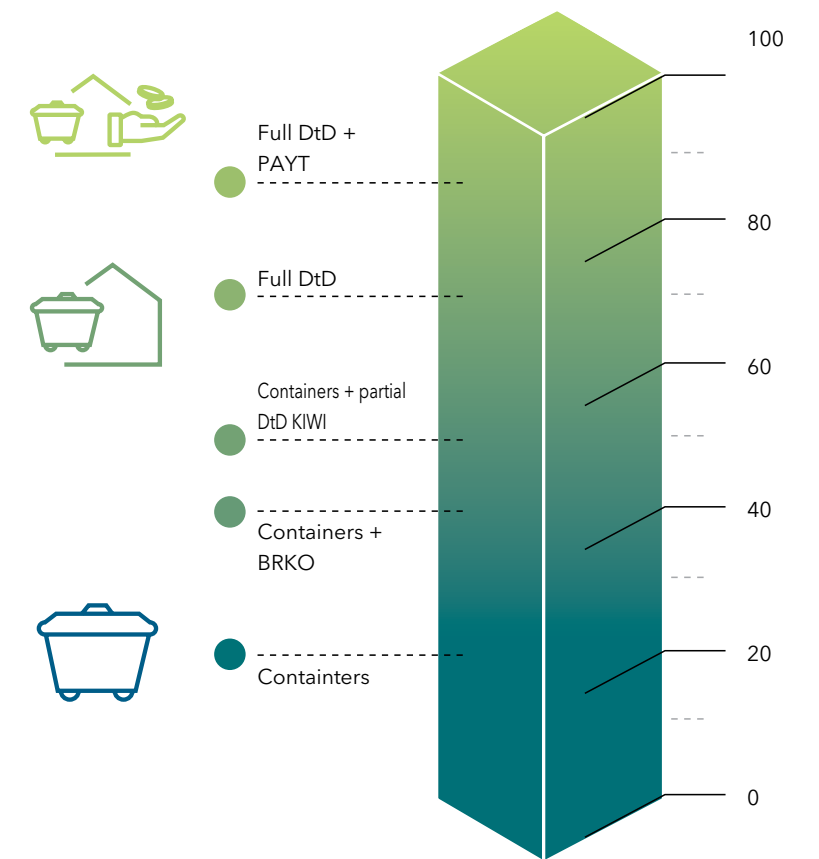
will then be introduced into the gas distribution infrastructure (it is now used for energy).

Biomethane sourced from bio-waste and wastewater treatment sludges will become a part of natural gas, renewable energies will then partially replace energies from fossil fuel sources. **Natural gas with added biomethane will then be utilised as vehicle fuel in Prague** (for Prague Services).

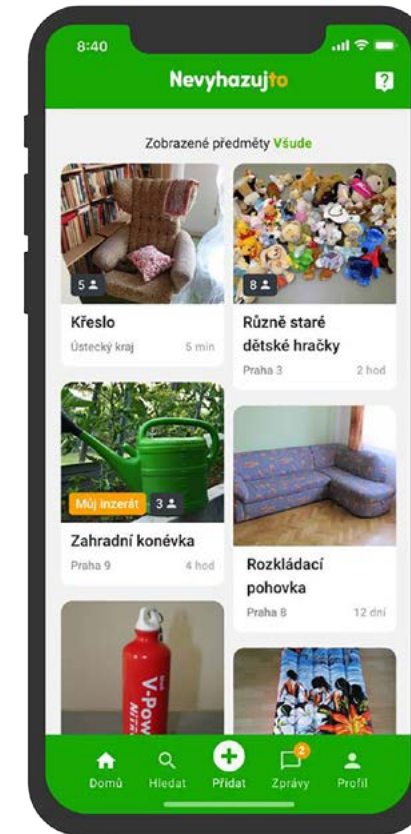
The introduction of multimodal collections of reusable materials from general household waste

Prague is currently planning the introduction of a multimodal, i.e., a shared container for the collection of plastics, metals, and drink cartons in one collection point instead of the current three. Following experiences from abroad, verified in a pilot project in Štěrboholy, this is likely to increase both

FIGURE 16 Rate of recycling according to types of collection systems



Explanation
 DtD = door to door, that is placing waste collection bins in courtyards
 PAYT - pay as you throw, that is paying for the true amounts of produced general household waste calculated from an actual record
 BRKO - biologically degradable household waste



The mobile app nevyhazuj.to makes it easy to offer things you no longer need. As a result, it reduces the amount of unnecessary waste.

the quantity and quality of recycled waste components. This will reduce the costs of collection, and less recycling bins will increase free public space available in the streets.

A sorting line which should be finished in 2022 in Chrástany will allow for a high-quality process of sorting plastic, metal, and non-ferrous metals, as well as drink cartons. The establishment of such a facility will allow the city to exercise more control over recycling of problematic materials (plastics).

Shifting recycling away from the street and into households and courtyards

Examples from abroad, the long-term increasing density of the recycling network in the city centre, and pilot projects in Prague 5, 6, and 7, or examples from Štěrboholy all illustrate that the closer the distance for people to recycling points, the better and more they recycle. This is why Prague supports the trend of gradual transfer of recycling from public spaces into households or courtyards (so-called door to door).

These measures intend to not only lead to a sharp rise in recycling connected to a better comfort of recycling waste for residents, but also to freeing up parts of public space, improvement in the aesthetic of public space, and limiting accumulating rubbish in the vicinity of collection points. However, the use of courtyards for recycling should not lead to the replacement of green or permeable surfaces with impermeable ones or to the destruction of greenery.

Prague bans single use plastic during public events, only allows returnable tableware

All cultural events financially supported by the Prague City Hall have banned single use plastic cups and food containers. They should be substituted with returnable glass or plastic tableware. This requirement will be applicable to all contracts closed since May 2019.³²



PRIORITY 3

Effectively recycling and reusing sorted secondary raw materials



The current sorting line does not allow fine enough sorting of waste materials for further use.

The new sorting technology will allow better sorting as well as more control over recycling problematic material.

The options of recycling and plastic leftover waste in Prague are expected to vastly improve with the modern sorting line for plastics, metals, and beverage cartons (currently an open call for suppliers and solutions, expected finalisation in planned for 2022). This line will be established on the premises of the current sorting line in Chrástany. The EddyCurrent

technology will allow for better sorting of ferrous and non-ferrous materials. NIR sensors will then ensure the collection of more than half of all plastic suitable for recycling. The equipment will allow the city to exercise more control over the recycling of problematic material (it currently leaves these tasks to outsourced companies).

³² See Prague City Hall press release: https://www.praha.eu/jnp/cz/o_meste/magistrat/tiskovy_servis/tiskove_zpravy/praha_na_svych_akcich_omezi_jednorazove.html [29]

What happens to sorted secondary raw materials in Prague

Recycling of plastics is complicated by their heterogeneity, together with their different mechanical and chemical properties. PET bottles are currently being successfully used to produce new ones with up to 80% share of recycled materials,³³ alternatively, they are also used for synthetic fibre production or for padding in clothing and shoes.

Other parts of the whole number of collected plastic waste are used to make fences, benches, grass pavers or cable ducts³⁴ or noise reduction panels³⁵. The surplus plastic waste is then used as an alternative fuel in cement production plants or in waste incineration plants or disposed of in landfill. A higher percentage of recycled materials could be achieved by a change in design of plastic packaging, higher efficiency sorting of yellow recycling collection bins, or by using recycled products in public procurement (e.g., placing noise reduction panels made from recycled plastic as opposed to concrete along roads and highways). It is also possible

to recycle plastic sorted from general waste (so-called scrap plastic). According to a life cycle assessment (LCA) a pallet made from recycled plastic by Stabilplastik s.r.o. near Prague has proven to have 74% less environmental impact than its commonly used wooden equivalent. Paradoxically, they are currently produced from imported plastic waste from Germany.³⁶

It is possible to recycle **paper** repeatedly to produce new paper products, and this process is currently not facing any difficulties, aside from small demand in times of economic crises. Paper recycling waste which cannot be further recycled may be composted or used in energy production.

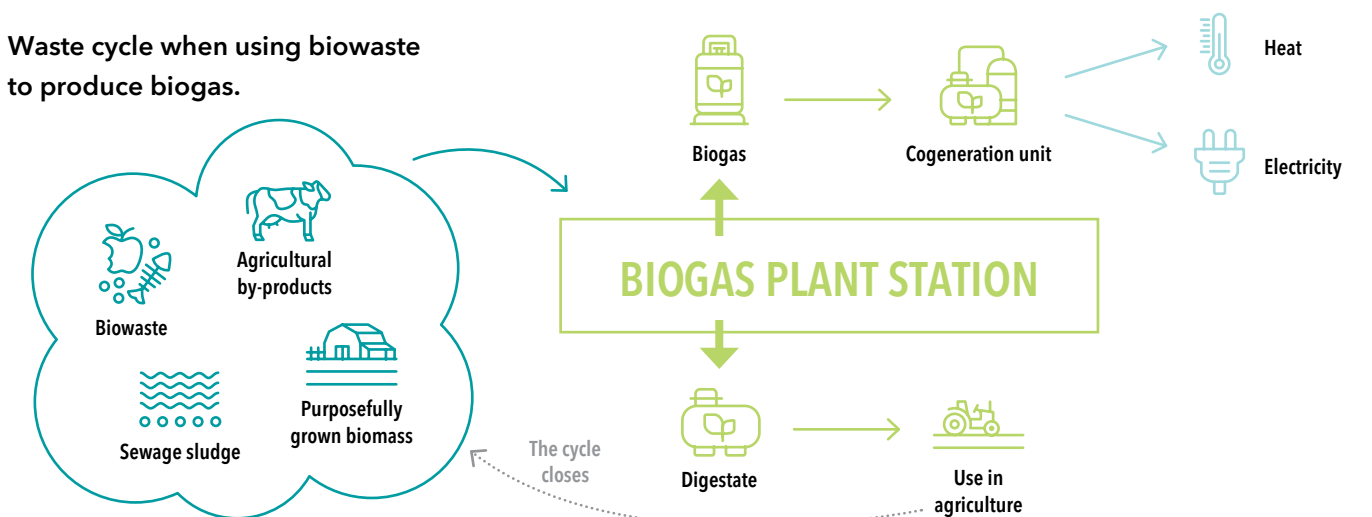
Beverage cartons are made of 70–90% cellulose fibres usable for the production of paper. However, cartons may also be compressed into slabs and used in construction or furniture.³⁷ Due to the composition of the packaging and its structure and the low costs of the raw materials, the costs of their recycling are problematic.

Glass recycling is a key part of the technology for glass production and is therefore in high demand. Issues arise from its weight and the increasing costs of its transport.

Ferrous and non-ferrous metals represent a high-value commodity which is used in the smelting of new products. The share of reusable metal drink containers and food packaging is relatively low; however, it is a newly collected commodity in Prague. One of the opportunities for the further development of its collection rates is to introduce multicommodity recycling, together with plastic and beverage cartons.

Bio-waste is a source of (plant-based) compost and due to the pilot project of kitchen waste collection it is currently used to produce biogas. The current numbers of this type of recycling are small and there is significant potential for its further development.

Waste cycle when using biowaste to produce biogas.



³³ <https://www.kosik.cz/stranky/z-lahve-bude-lahev?kampan=paticka> [31]

³⁴ <https://www.recyklace.cz> [32]

³⁵ <https://www.mosevplast.cz> [33]

³⁶ <https://www.stabilplastik.cz> [34]

³⁷ <https://stavba.tzb-info.cz/podlahy-pricky-povrchy/19380-desky-packwall-po-stopach-recyklace-napojovych-kartonu> [35]

PRIORITY 4

Introducing principles of the circular economy into the building and demolition sector



Almost 90% of materials in the segment of building construction is obtained from primary sources.

Excavation and demolition materials are used for new constructions and development. Detailed database of construction materials helps in decision making how to (re)use them after the period of their use.

The Prague building and construction sector is one of the most demanding economic sectors in terms of resources, and as such it possesses enormous potential for transformation which could aid Prague in its transition towards a circular economy.

Project Circular scan Prague with the Prague building sector identified some key facts: Every year, around 3 million tonnes of construction waste is generated within the city area which represents approximately 78% of all waste produced in Prague. During the same time period, more than 13 million tonnes of material is used for the purposes of construction. Approximately 1,200,000 tonnes of building and demolition waste are recycled every year. In terms of material input, however, almost 90% of materials are obtained from primary sources and therefore leave a much more significant ecological footprint than secondary materials.³⁸

The following opportunities may therefore be identified for a transformation of the building and demolition sector in Prague:

More frequent use of secondary materials

According to the Circular Scan Prague project around 10% of building materials currently come from secondary sources while the other 90% represent primary materials with a significant ecological footprint. As a result, the Prague building and construction sector possesses a great opportunity to increase the overall share of materials obtained from secondary sources and therefore lower its ecological footprint.

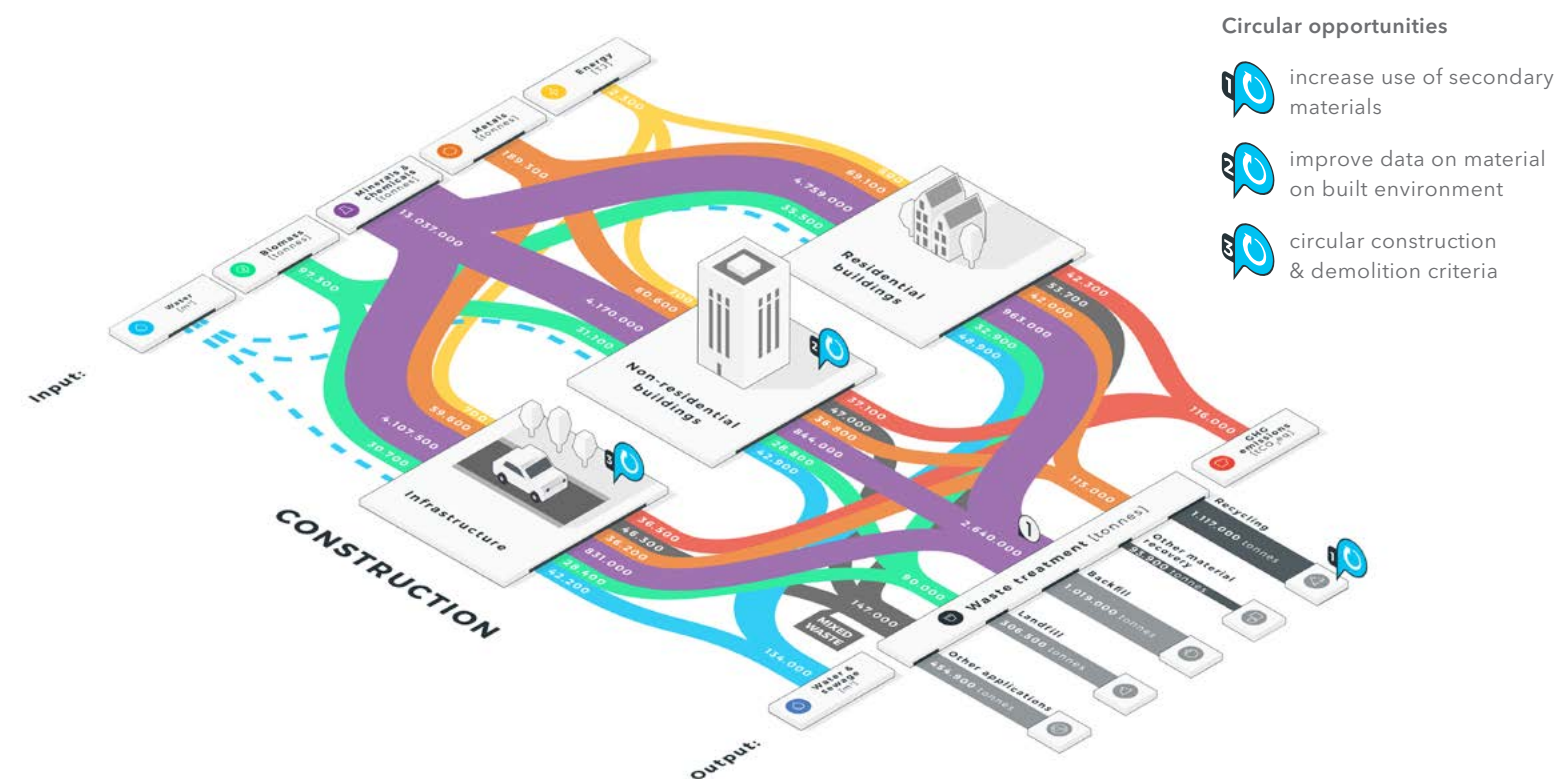
The opportunities for Prague in the use of secondary sources and renewable materials in construction are the following: utilising slag produced from road-works, using materials and sludge extracted from local wastewater treatment plants as construction material, as well as utilising recycled and renewable elements in construction materials.

The usage of these options is contingent on compliance with all relevant hygiene norms and regulations concerning health and the environment.

³⁸ <https://incien.org/publikace/publication-cirkularni-sken-praha-cze/> [36]

FIGURE 17 Opportunities for implementation of circular economy principles in construction sector based on material flow analysis

Taken from the Circular Prague analysis (www.circle-economy.com/resources/circular-prague)



Refine details concerning materials in built up areas

Materials embedded in Prague’s buildings should be monitored during the entirety of their life cycle with the aim to allow for effective decision making after the period of their use is over and therefore lead to a higher circularity of the sector. Such a central database is currently unavailable, and its establishment represents an opportunity for prolonging the life cycle of buildings and materials embedded in them.

Criteria for circularity of building and demolition

During the preparation of new building projects and communication with developers, Prague should request excavation and demolition materials to be used for new constructions or development, together with recycled concrete. Inspiration for these measures comes from practices in Copenhagen³⁹ and Berlin⁴⁰.

³⁹ During a school reconstruction, the city of Copenhagen specifically requested the reuse of bricks, which were sourced from the ongoing demolition of nearby hospitals. As a result, the total costs and produced CO₂ emissions were reduced [37].

⁴⁰ In order to overcome preconceptions and stimulate market demand for recycled concrete in the construction industry, the Federal State of Berlin requested the use of recycled concrete in the construction of a new university building. This reduced the amount of primary materials used by 880 m³ and energy consumption by 66% [38].

PRIORITY 5

Cooperating with ministries and other sections of government administration, industry, experts, and the public

Responsibility (including financial) for the sorting and recycling of packaging, electronics or batteries, is by law in the hands of the relevant industry. Prague can exercise pressure on the state to widen the range of products which should become the responsibility of their producers, to introduce deposit systems, create more advantages for industrial recycling of sorted materials, or improved the accessibility of repair services (such as "Opravná"⁴¹ repair shop).

Examples from progressive cities abroad show that a key feature of increase in recycling is to utilise innovative approaches and technologies. By supporting acceleration and innovation programmes, cooperation with universities, or by organising hackathons, Prague may clear the way for more business and work opportunities. Prevention and the sorting of waste relies on a wide participation from households and individuals. As a result, Prague must broaden and intensify its efforts in communication with the public.

HOW TO MEET THE GOALS

List of proposed measures

- 1 **Create a Strategy for transition to a circular economy and ensure its ongoing implementation.** Using other European cities as an example, the City Council assigned the preparation of a strategy for circular economy. The implementation of all accessible measures could bring a reduction of 2.5-5% of all city produced emission.
- 2 **Less waste produced by the city hall and from events supported by the city.** Regulations which limit the use of single use packaging and products during city organised or supported events will gradually be implemented in public procurement in other sectors.
- 3 **Biogas from bio-waste as car fuel.** Prague plans to extend its pilot project⁴² for sorting bio-waste from "non plant-based" sources (Prague 5, 6, and 7) for the entire city. To ensure its meaningful implementation is supported by the construction of a new biogas station. From 50,000 tonnes of collected biodegradable waste, it will produce 5 million m³ of biomethane a year which will be compressed into the existing natural gas infrastructure. The waste from these biogas stations - digestate - may be used as organic fertiliser after appropriate treatment. Prague sources more biomethane from waste water treatment sludges produced by the Prague Central Water Treatment Plant.

⁴¹ www.opravarna.cz

⁴² See Prague City Hall press release: http://portalzp.praha.eu/jnp/cz/tiskove_zpravy_z_mesta/praha_spustila_pilotni_projekt_svozu.html [40]

Following the intensification project and increase in capacity, and the installation of more effective technologies, its production is likely to slightly increase and will be partially fed into the natural gas infrastructure. Biomethane sourced from bio-waste and wastewater treatment will become a part of natural gas, renewable energy will therefore replace a portion of fossil fuels. Natural gas with additional biomethane will be used to power Prague's vehicles, for example the Prague Services fleet.

- 4 **Introduce multimodal sorting of plastic, metal, and beverage cartons.** Evaluating the results of the pilot project from the city district of Štěrboholý, the common collection of plastic, metal and beverage cartons into a single recycling bin will be applied to other city districts. This will increase the quality and quantity of sorted materials, reduce the costs of collections, and free up space in the streets. A condition for the implementation of multicommodity sorting is the opening of a new sorting facility in Chřáštany u Prahy.
- 5 **Move most recycling from the streets into courtyards (door to door).** The expansion of pilot projects would bring about smaller collection bins moved to building courtyards and common spaces which will lead to higher rates of recycling and free up public space, as well as prevent littering in the vicinity of collection points.
- 6 **Build a modern sorting line for plastics, metals, and beverage cartons.** The sorting line, which will be finalised in 2022 in Chřáštany will allow more efficient sorting of plastic, ferrous and non-ferrous metals and beverage cartons. The facility will allow the city to exercise more control over the recycling of problematic materials (plastics).
- 7 **Support a second life for furniture and other goods.** A construction of a central re-use centre should have a major educational, inspirational, and environmental impact. It represents a space for innovative projects of sustainable character which will be organised with a participative approach.
- 8 **Change building and demolition principles.** To fulfil Prague's climate pledge, it will be necessary to form a strategy, regulations and projects which will apply the principles of a circular economy into new building methods, demolitions, and reconstructions.
- 9 **Establish the Circular Prague platform.** The aim of the platform is to allow companies to participate in the transition of Prague to a circular economy and utilise their potential and participation in volunteering activities.
- 10 **Introduce ecological and circular public procurement policies.** Prague should set an example in the application of the circular economy into its internal processes. The city should create effective and favourable conditions for services, products, and solutions integrating principles of circular economy when drafting documents for outsourcing principles.
- 11 **Capacity building for circular economy** in the internal structures of the Prague City Hall. It is crucial to allow for the necessary staffing positions to be created within the PCH with competencies which allow for a continual introduction of circular economy into the city's operations.

Adaptation Measures

Adaptation measures do not have a direct impact on lowering CO₂ emissions. They aim to **improve the quality of life** of Prague's residents among ongoing changes in climate.

An overview of the planned measures is listed in the current Implementation Plan for 2020-2024 (approved in a Decision of the Prague City Council No. 1936, from Sep 7, 2020). A key section of the Implementation Plan is the repository of 207 planned measures. These approved can be divided into the following priorities and topics:

CORE PRIORITIES

Improving micro-climatic conditions

See how can planting greenery and expanding water areas improve living conditions.

→ [p. 109](#)

Lessening the impact of extreme hydrological events

Water management measures help prevent flash floods or droughts.

→ [p. 113](#)

Adaptation of buildings and the environment

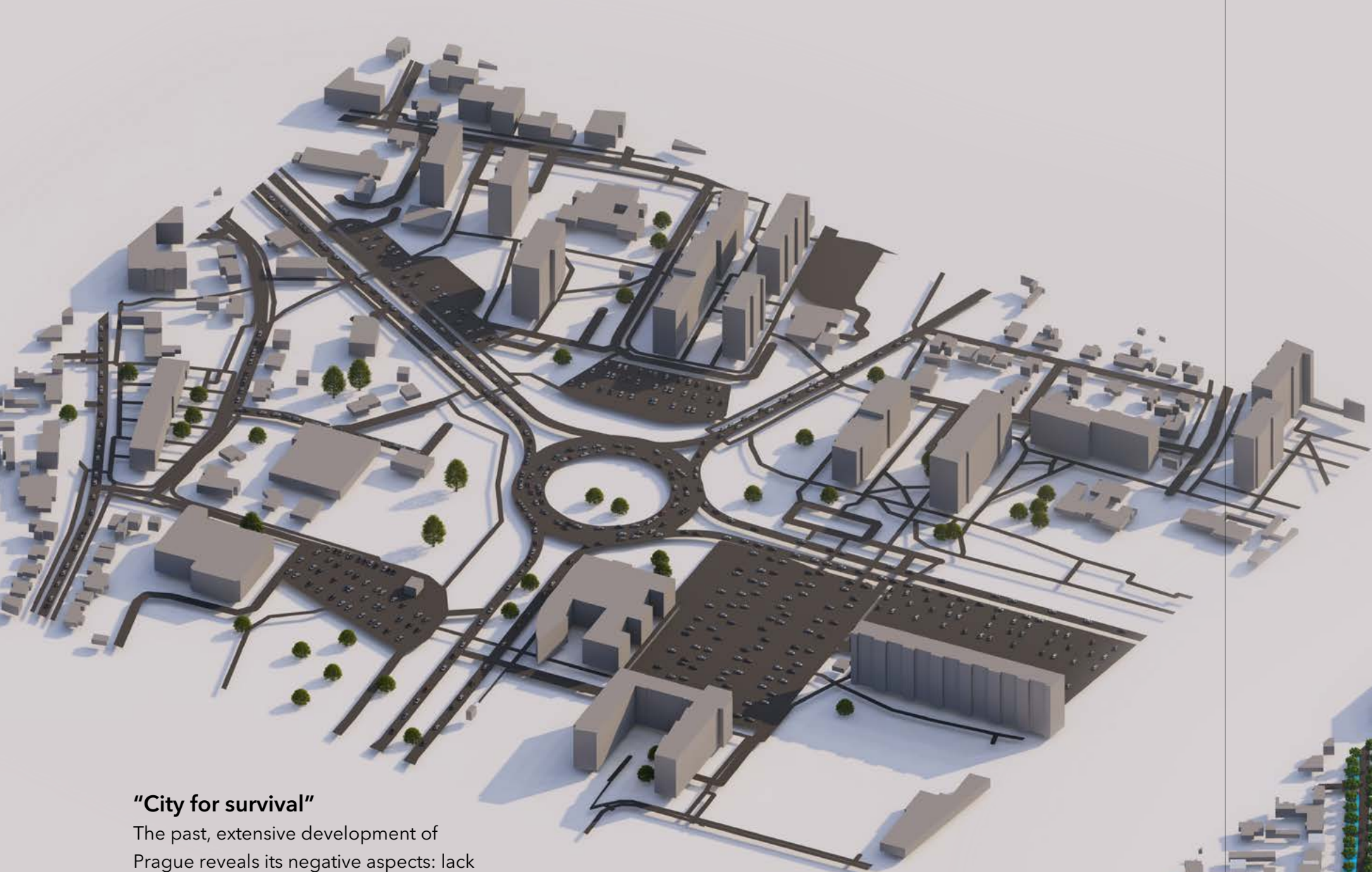
How to design the environment and buildings to make it pleasant and sustainable.

→ [p. 115](#)

Increasing preparedness in crisis management

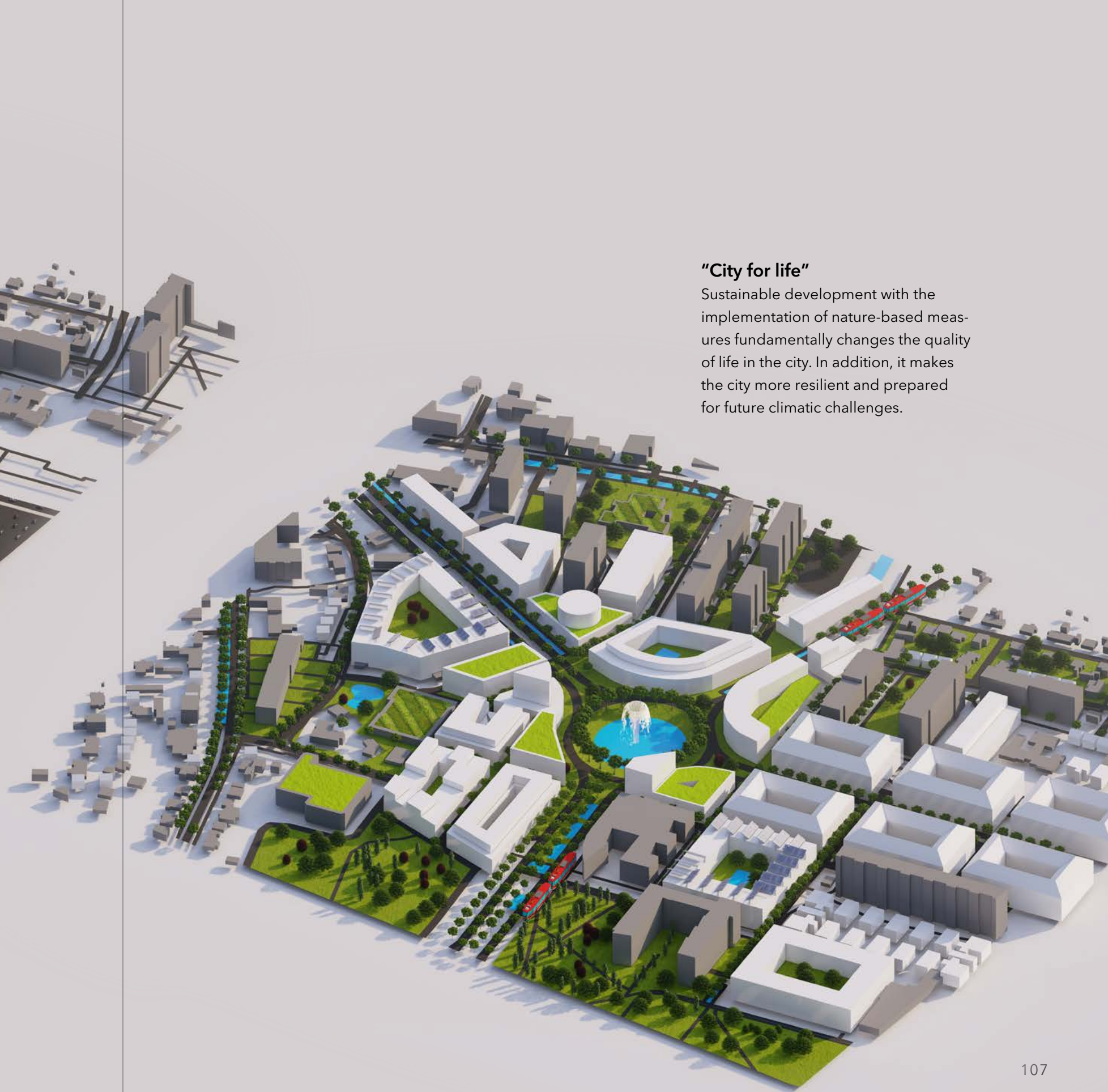
To be resilient, the city has to be prepared for various shocks caused by the climate change. How to measure it and evaluate it?

→ [p. 123](#)



“City for survival”

The past, extensive development of Prague reveals its negative aspects: lack of quality public spaces, long distances, lack of greenery, vulnerability to heat, drought or torrential rain - to name just a few. The assumption that a city may exist detached from natural conditions proves to be incorrect.



“City for life”

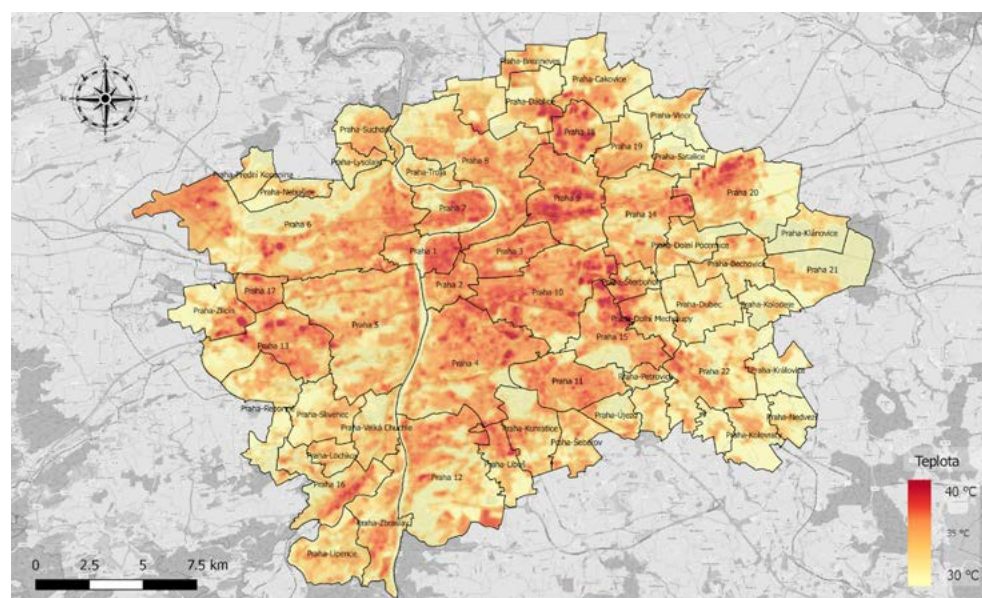
Sustainable development with the implementation of nature-based measures fundamentally changes the quality of life in the city. In addition, it makes the city more resilient and prepared for future climatic challenges.

Ongoing climate change is manifesting as a steady increase in mean annual temperatures and is reflected in the growing number of warm weather fronts, their heightened intensity and longer duration of periods of extremely high temperatures and recorded tropical days (above 30°C) and nights (above 20°C). Annual distribution of precipitation is changing - increases in precipitation during the winter months and their decline during the summer are becoming more common, and numbers of days with zero precipitation altogether are rising. A specific phenomenon of large cities is the so-called urban heat island effect, where asphalt and concrete surfaces of roads and housing blocks create "heat islands" which continue to radiate heat during the night and the temperature of which remains up to 8°C higher than the surrounding green areas in the city's outskirts, thus negatively impacting living conditions and health of residents.

Prague as a metropolis has committed to reducing the negative impacts of climate change and improving living conditions for its inhabitants in 2017.

Following the national Strategy on Adaptation to climate change in the Czech Republic the city produced and approved its own Capital City of Prague Climate Change Adaptation Strategy (referred to as "Adaptation Strategy"), and the relevant Implementation Plans.⁴³ As part of the implantation plans, a live repository of projects was created, which incorporates their evaluation using indicators. As a result, Prague is able to choose those projects, which show the most effectiveness in their solutions and support their implementation.

At the same time, monitoring of heat zones,⁴⁴ exposition and adaptation indexes of the Capital City of Prague is also undertaken, as one of many actions. In this context, individual indicators will be assessed (i.e., exposition, adaptation capacity) before and after the implementation of adaptation measures. The metropolis will gain its own unified system of data collection and processing, primarily with the help of experts from Prague IPR, but also with cooperation of other private entities invited to participate.



Maximum surface temperatures in Prague in 2019
Evaluation of the urban heat vulnerability of public transport stops, Ecoten Urban Comfort, s.r.o., February 2020 [43]

⁴³ www.adaptacepraha.cz [41]

⁴⁴ https://app.iprpraha.cz/apl/app/ndvi_teplota/ [42]

PRIORITY 1

Improving microclimatic conditions



In the last decade a number of projects have been realised that shown the good practices for improvement.

Blue and green infrastructure are considered as necessary for the city to live in. Small water reservoirs as well as diverse types of greenery are natural part of Prague public space.

Revitalisation of parks, green and paved surfaces, and planting of greenery

The proposed measures focus on the introduction of new and revitalisation of current park spaces which no longer serve their function, partial transformation of roads from impermeable to permeable surfaces, revitalisation of lawns, introduction of watering systems, planting of trees and their care, and the overall improvement of the ecological value of the city. From the perspective of adaptation, the value of trees in street or small park spaces in Prague is much larger than introducing new individuals. Alleys and their trees are also crucial for retaining suitable microclimatic conditions of the city.

Forests

Forests are ecosystems with a large capacity for carbon dioxide retention which may partially balance carbon footprints of other sectors. Prague forests are managed according to FSC and PEFC certifications which draw on sustainable development policies.

Unfortunately, the effects of climate change are being manifested in Prague forests in the form of insect calamities and the drying out of forest beds.

As a part of adaptation measures, it is therefore important to take into consideration forest care and their renewal, new forest areas, and also gradual purchases of forested areas from private owners.

Renaturation and creation of new bodies of water, wetlands, river and small stream floodplains

It is possible to integrate slowing of surface runoff in the landscape and lessening the negative impacts of flooding in urban areas during periods of high intensity precipitation together with improving the aesthetic and recreational function of the landscape.

River beds which have been straightened will be redirected back to their floodplains in a series of selected measures to form meandering streams with natural pools. A part of the revitalisation process is also planting of forests, renewal of meadows, construction of appropriate infrastructure, as well as the introduction of a system of small water bodies. The aim of these measures is to retain water in the landscape and create eco-friendly conditions for water streams, to support biodiversity, and to increase green areas and improve the recreational potential of the city's landscape.

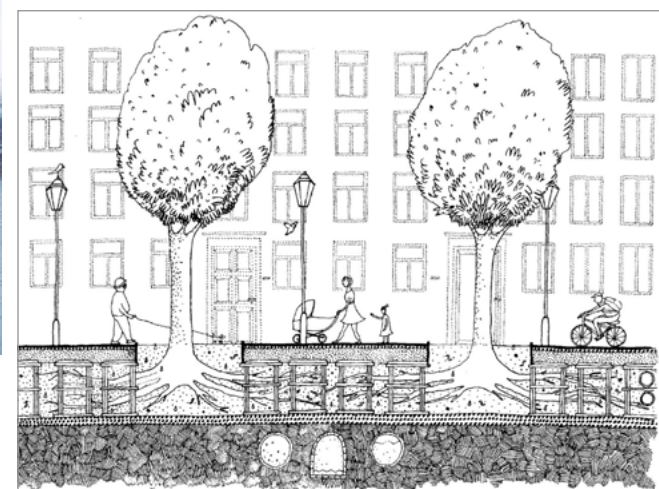
Supporting recycling and the use of wastewater

The use of "grey" water for flushing of toilets or watering plants saves both water and energy. Recycled wastewater can be used to water wetland roofs, flower beds, and other types of vegetation elements in the public space, as well as cool down surrounding areas through evaporation.



Gradual transformation of impermeable surfaces to those with permeable or semi-permeable properties

The project repository includes projects which plan a transformation of impermeable surfaces of playgrounds, roads, and parking spaces and other surfaces with the use of grass pavers, gravel or dirt paths to reduce surface water runoff, or to increase the groundwater reserves in certain locations.



An innovative technology for improving city environment is the implementation of underground rooting spaces by use of the rooting soil cells. The main advantage of this solution is, in addition to easier irrigation and sufficient space for roots, also the possibility of planting close to technical infrastructure. PHOTO AND SKETCH: STEINER A MALÍKOVÁ KRAJINÁŘSTÍ ARCHITEKTI



Revitalisation of Divoká Moldau as part of the Císařský Ostrov Action Plan, IPR Praha. The aim of this project is to improve (visualisation above, as is situation below) the passage through the Moldau river profile, renew its hydro-morphological conditions in the Troja basin, as well as support biodiversity and biotopes of selected species. It also aims to improve the species migration capacities of the Troja weir, reinstate landscape values of the floodplains and the river, create new opportunities for recreation and leisure activities for Prague's residents, as well as create more space for education and outreach. Its realisation is expected for 2023 and 2027. VISUALISATION AND PHOTO: IPR PRAHA



An important project of recent years is the revitalisation of old Prague orchards. PHOTO: PRAHA-PRIRODA.CZ, OCP MHMP



In the peripheral areas of Prague, recreational areas of cultivated landscapes are emerging. The photo depicts the forest park Letňany. PHOTO: PRAHA-PRIRODA.CZ, OCP MHMP

Revitalisation of Radiovka apple orchard, Prague-Satalice

The intensive apple orchard was founded between the late 60s and early 70s on low trunks to ensure high fruit yields. After thirty years lacking the appropriate care, the orchard was abandoned and empty spaces between the fruit trees were overgrown with vegetation, becoming inaccessible, and the orchard was littered with a large amount of waste. After clearing of the orchard area, new meadow type vegetation will be introduced with several types of fruit trees from dwarfing to semi-dwarfing and standard varieties. The area will be fenced off and will serve as a recreational space. A new playground area for children of various ages will be added, including spaces for entire classes of kindergarten and elementary school children to use. The orchard will be used for purposes of family recreation, sport, and due to its flat terrain, it will also be accessible to less mobile seniors. Its realisation is expected in 2020-2024.



Revitalisation of the Rokytká basin in three sections of the Hloubětín and Hrdlořezy area, Environmental Protection Department PCH. The bed of the Rokytká stream will be widened, its banks will be less steep, and meanders will be created, together with access to the stream. The aim is to retain water in the landscape, create an eco-friendly situation for water streams, support biodiversity, increase green areas and improve the recreational potential of the city's landscape. Its realisation is planned for 2021-2022. PHOTO: PRAHA-PRIRODA.CZ, OCP MHMP



Restoration of the water system of Prague's Stromovka Royal Game Reserve, which was part of the complex revitalization of this popular landscape park, created a pleasant environment. PHOTO: LUBOMÍR STIBUREK



Revitalisation of Baba, city district Prague 6. This project intends to reduce the ratio of paved surfaces, increase the use of rainwater for the purposes of watering newly planted tree groups, slow rainwater runoff from road surfaces and from parking spaces into the sewage system. VISUALISATION: IPR PRAHA



Revitalisation of Karlovo square, city district Prague 2. The revitalisation project of the heritage protected park will improve its accessibility and conditions for the growth of trees, as well as their gradual renewal. A new more effective rainwater management will also be introduced in the square. This project is planned for 2023-2025. VISUALISATION: IPR PRAHA

PRIORITY 2

Lessening the impact of extreme hydrological events



Rainwater management measures are neither standardised, nor compulsory to implement.

Implementation of nature-based solutions for the slowing or retaining of rainwater in Prague is binding for all development projects.

Rainwater management

Other than increasing the ratio of green surfaces and bodies of water, another crucial priority for Prague is to improve rainwater management. As part of this measure, Prague is currently preparing a document titled "Standards for rainwater management" which should be binding for all new developer projects in the city area, as well as for all actors approving and managing these projects.

These standards will include proposals for individual technical solutions relating to the place of realisation (residential apartment buildings, industrial buildings, tramway lines, etc.). The objective of this measure is to provide maximum priority for nature-based solutions for the slowing or retaining of rainwater in Prague, primarily utilising bioswales, retention and accumulation basins, transformation of impermeable surfaces to permeable ones, realisation of green roofs, and others in order to prevent direct surface runoff into the sewage network without the opportunity for its reuse for, e.g. watering of greenery. The city should ensure the support of such solutions and accept them into the management system, together with securing their appropriate upkeep.



A range of nature-based measures is already applied in cities to slow and retain rainwater. Building blue-green infrastructure should be binding for all future development projects. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI



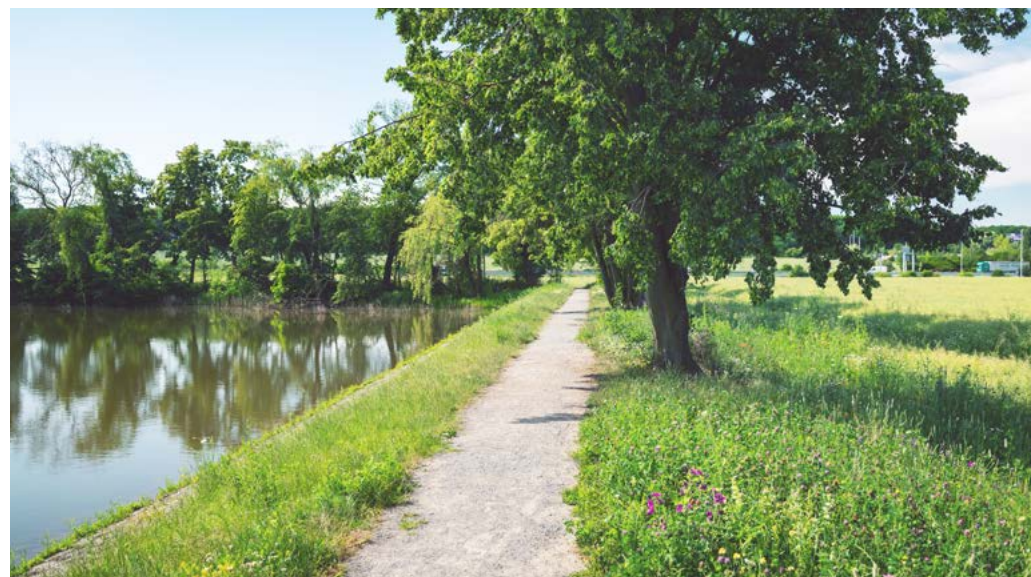
The development project SUOMI Hloubětín residence is the first project of such a scale with responsible rainwater management in the City of Prague. A range of measures ensures that water seeps directly into the ground. The outflow of rainwater from the area is slowed down by means of retention tanks, infiltration rigs around the roads lined with intermittent curbs, flooding infiltration meadows and a nature-like central lake. There is also a green courtyard and newly planted trees, which are irrigated using an underground drainage system and a runoff water from the slope (above).

PHOTO: NADACE PARTNERSTVÍ / VOJTA HEROUT



Water from the roads in SUOMI Hloubětín residence flows – thanks to the correct inclination of the road and intermittent curbs – directly to the gravel beds, where it seeps. PHOTO:

NADACE PARTNERSTVÍ / VOJTA HEROUT



The area between the D8 motorway and Horní Počernice in Prague was until recently inhospitable and difficult to access. As part of creation of the V Ladech landscape park, two ponds were revitalized and cleaned, and the original meandering form was restored to the Svěpravický stream. The sediments taken out of the revitalized ponds were used to build a noise barrier. PHOTO: NADACE PARTNERSTVÍ/VOJTA HEROUT

PRIORITY 3

Adaptation of buildings and the environment

The investors slowly discover the economic potential of building green and sustainably.

Green roofs, vertical gardens, green facades and similar elements that improve energy efficiency of buildings and create a pleasant environment has become a standard of all new construction projects.



Adaptation of buildings – technical measures, green roofs

The Adaptation Strategy also envisages measures which aim to produce a sustainable and climate friendly metropolis that emphasises the use of alternative sources of energy (more on this is available in the energy chapter of this document). In this direction, Prague is planning a number of projects which should lead to energy savings in the city's buildings. In the future, Prague will witness higher rates of solar energy installations, both independent and integrated with green roofs, or the heating of houses with the use of heat pumps.

These measures include projects concerning the outer shell of buildings (materials and their colours, roofs, ceilings, outer walls, the establishment of green roofs and façades), aiming to increase the thermal comfort of buildings and propose changes to building projects (use of IT technologies for the optimisation of heat comfort, PV installations, rainwater retention, shading, recycling of processed wastewater) with the aim to minimise carbon footprint and increase the share of energy produced from RES, thus contributing to a vision of an energy self-sufficient city. The im-

provement of energy efficiency of buildings is a step forward towards resilience to climate change for the Capital City of Prague.

Adaptation measures for the streets – planting of vertical and mobile green spaces and green façades

The use of greenery in facades and walls contributes to a reduction in the absorption and accumulation of solar rays in buildings and their vicinity (playgrounds, parking spaces, etc.). They improve the city's microclimate and increase its ecological value, while also reducing dust levels in the immediate surroundings. Other benefits include noise reduction, aesthetic value, and air quality improvements.

To allow for easier stay in the metropolis' street spaces during heat waves, the implementation standards for misting devices have already been compiled and a concept for new drinking fountains has been approved. The standards were set so that these features may be easily connected to pre-existing hydrants and therefore make the implementation easier for interested parties from city districts to install in their areas. A part of these solutions is also



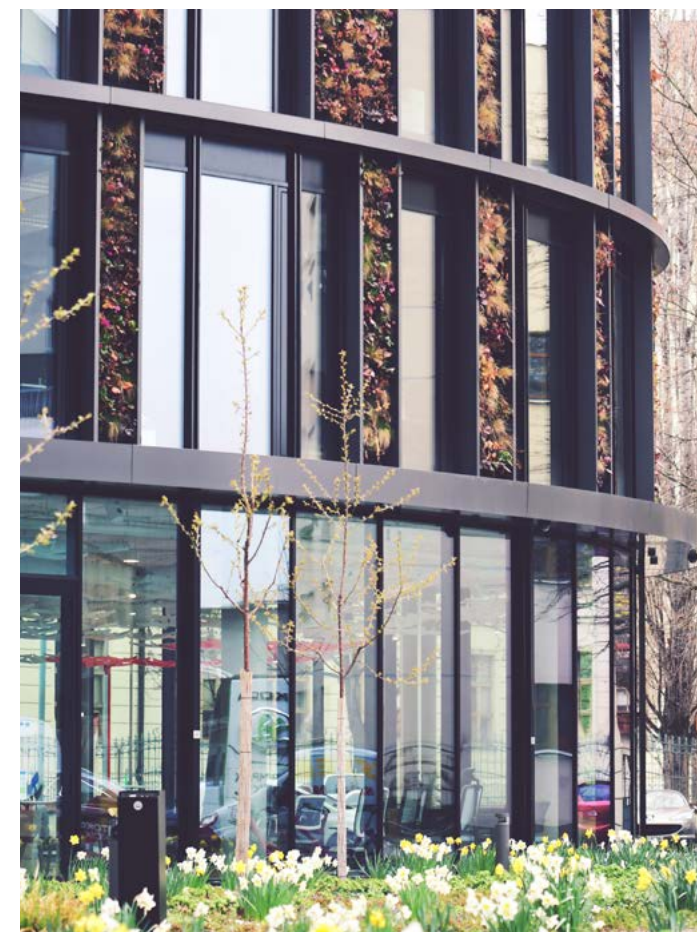
Mosaic House Design Hotel Prague is the first Czech green hotel with a system for the use of gray water and heat recovery from wastewater that uses renewable energy sources. For its innovation the hotel was awarded in the Adapterra Awards Competition that focuses on best practices of adaptation to climate change. PHOTO: NADACE PARTNERSTVÍ / VOJTA HEROUT



The Pavilion of tropical agriculture of the Czech University of Life Sciences was designed with respect to its sustainability. It includes heat pumps, rainwater retention tanks, photovoltaic panels as well as a green roof. PHOTO: NADACE PARTNERSTVÍ / VOJTA HEROUT



Drn Palace at Národní třída refers already in its name (translated as Turf) to greenery which grows in all levels of the building. PHOTO: PETR HOLÝ, OCP MHMP



Green facades are increasingly popular for use on new office buildings. PHOTO: ANTONÍN KEPRTA, OCP MHMP

“Smart buildings”, supporting energy sensitive solutions for new buildings and the realisation of green roofs, city district Prague 7

The aim of the project is to implement, consistently require, and support the implementation of green roofs for new buildings in Prague 7, respect the natural terrain, and use all options of plant placements, including vining plants on façades. One of the desired outcomes is also to fit buildings of elementary schools and kindergartens within the city district with greenery. For new structures, the main aim is support and emphasis on energy efficient solutions. The district plans to announce an architectural competition for a new school building in Jankovcova street. This project should fulfil the above-mentioned aims to the utmost extent. The expected realisation of this project is 2021.



Establishing community gardens is a way to improve the microclimate while offering leisure family activities. PHOTO: KOKOZA,O.P.S

the servicing and management of these features by the city.

Constructed wetlands (wetland beds, roofs, root zone wastewater treatment of sewerage in public spaces) can lower the surrounding temperature through evapotranspiration, and therefore create green spaces which do not necessitate watering even on hot days. These nature-based systems of treatment can also produce clean water for below-surface watering of trees and lawns.

The city of Prague is preparing to collaborate with city districts and residents of courtyard-type housing in relation to introducing relaxation spaces, use of rainwater and improving microclimatic conditions through their renewal and realisation of improvements. As part of the Implementation Plan 2018-2019, the Living Courtyards methodological publication was issued, which was able to raise awareness of the benefits of green spaces, as well as provide a basic outline of the options for transformation of courtyards through nature-based approaches for interested parties to create spaces which contribute to reducing the impacts of climate change and serve other social functions. The next step will be preparation of specific



New public space between the historic and the new building of the National Museum. PHOTO: IPR PRAHA

technical suggestions, including plans for the placement of greenery and mapping of courtyards for the allocation of possible grants from the city.

Establishment and support for neighbourhood and community gardens, eco-gardening, and support of sustainable agriculture

In a similar fashion, the city published a Methodology for Community Gardens and more steps are in preparation for the support of their realisation and operations.

With the support of creating and revitalising sustainable agriculture, gardening and community garden spaces, the overall potential of green infrastructure features is rising, the city's microclimatic conditions are improving, and biodiversity of the agricultural landscape is increasing, as is the ecological value of whole areas.

There are over 14,000 hectares of agricultural land within the city's territory, with 1,650 of those being directly managed by the city hall. The metropolis adopted a management plan in 2019 titled "principles of eco-friendly land management in the Capital City of Prague". Large areas will be divided by dirt



The common practice of planting trees used to be to keep them isolated with a minimum of space for the root system (left). In contrast, planting in flowerbed lines provides trees with better irrigation and more space, and also better completes the street space. ILLUSTRATION: JAKUB CIGLER ARCHITEKTI



roads, boundaries, hedgerows, and tree alleys to prevent loss of quality soil and erosion. The city will then invite individual city districts to join.

Agricultural lands in city ownership have until recently been leased out to tenant farmers who used the soil primarily for intensive agriculture. In 2019, Prague terminated all pre-existing contracts and introduced a new process where the renters are responsible for keeping to eco-friendly agricultural standards - alternate planting following crop rotation plans, ensuring the sowing of catch crops, correct methods of ploughing, limited use of chemicals when tilling the soil; use of organic fertilisers; individual single crop fields now cannot be larger than 5 ha, or must be divided using dirt roads, boundaries, hedgerows, and tree alleys. An interest in moving towards responsible agriculture has already been expressed by some city districts, including Prague 12, Prague Vinoř, and others.

Planting, renewal and management of trees, tree avenues, and other tree groups

Trees in city spaces play a vital role in adaptation to climate change, as they create better microclimatic conditions in their vicinity through transpira-

tion, which then cools down their surroundings and provides shade, which in turn lowers the perceived temperature around it and purifies air from pollutants. For a tree to "function" properly it has to have the right conditions for growth and adequate watering access. The realised measures therefore focus on planting of trees in Prague but also on creating guidelines for care and renewal of tree alleys within the city's boundaries.

The action plan expects to plant one million trees in the city during the 2018-2021 period. Outside of this plan, more planting is expected by city districts, organisations founded or owned by the city, or developers and private landowners. To plant a tree is an important first step, but not the only one. Aside from sufficient watering, it is important to choose the adequate placement and a suitable species so that the tree may provide all the desirable functions for improving the life of city inhabitants. Ensuring quality care and management for trees and tree alleys is a key tool for supporting their desirable functions in the city. These emerging guidelines will guarantee that trees gain their right places in Prague and are provided adequate care for their growth.



Revitalisation of Rohan and Libeň islands. The landscape and conceptual study is being prepared by IPR as a basis for the revitalisation of the Rohan and Libeň island areas for park use with a natural character and a city-wide importance. The Rohan island project realisation is planned by the city for 2021–2028. The project will improve the current conditions for recreation and flood prevention functions. It will also improve landscape permeability, lessen the effect of the city heat island, and increase the effectiveness of rainwater management. SOURCE: IPR PRAHA



Construction of a green wall of hops on Vítězné náměstí, city district Prague 6 (above). The project aims to separate the living spaces of the cultural garden Šesták from the highly frequented roundabout on Vítězné náměstí. This redirection will be realised with the help of a green wall made of the common hop species (*humulus lupulus*). The construction of the hop trellis will be installed in the atypical wooden planter currently placed in Vítězné náměstí near the area of the Šesták garden. The realisation of this project will not only aid to separate this area from the highly frequented traffic communication of the roundabout, but it will also contribute to an increase in the surface of green areas and partially to shade a part of the sitting areas of the Šesták garden. This project was initiated in 2020. It should be followed by further reconstruction of the square (right), which should be transformed from a busy intersection into a lively place. SOURCE: IPR PRAHA, PHOTO ABOVE: JAKUB CIGLER ARCHITEKTI



Revitalisation of Dukelských hrdinů, Strojnická and U Výstaviště (Letenský kříž) streets, city district Prague 7
The project lies in outlining placements, constructions for root spaces and the planting of tree alleys, as well as ensuring sufficient aftercare in relevant streets. The investment should secure long-term prospects for tree growth in their placement sites. The condition of such investments is the relocation of public utility infrastructure; the outcome of a study conducted by IPR Praha is the preparation and discussion of coordinated statements concerning spatial and building planning processes. The realisation itself is then the responsibility of the city hall. SOURCE: IPR PRAHA

Organic agricultural economy

The city selected 398 ha of its agricultural lands which it offered up for tenancy in 2020 with conditions of organic agriculture. In the period between May and June 2020 a selection process of choosing tenants for these agricultural plots was conducted according to the new regula-

tions, formulated with the principles of responsible approaches to the landscape and biodiversity (subdivision of fields into smaller sections with a maximum size of 5 ha, division of fields with hedgerows, trees, and grass boundaries, planting of tree alleys, prioritising crops which do

not increase soil erosion, requirement to conduct deep soil ploughing annually, limitations on the use of pesticides, herbicides and mineral fertilisers, and especially an emphasis on adequate sowing steps.

Construction of a vertical community garden at Hybernská Campus, Prague 1

In an ideal circular city, all food consumed by households will be produced in sustainable ways, they will be healthy and come from local sources to minimise negative environmental impacts. Food waste will be reduced, and unavoidable waste will be used in stepped cycles.

City agriculture could be used as a good strategy for shortening the supply chain of foodstuffs for city consumption and to allow a higher consumption of healthy food produced through sustainable ways.

A greenhouse will be used for community planting of herbs and vegetab-

les. Thanks to the hydroponics technique, space, water, and other materials will be saved.

The aim of the project is to supply fresh vegetables and herbs for campus visitors and students.

Concept of development and evaluation of current undeveloped or unused land and brownfields

The trend of increasing transformations of landscape areas with a natural character into urbanised spaces or building new communication routes is unsustainable. Often, the spaces which are taken lie near residential areas or in the suburban landscape near core traffic connections. These areas are not understood under the current legislation as important enough to be protected.

It is a pity when green lands only serve as waiting grounds for the construction of motorways, airports, and other structures; these areas often represent the most prized sections of the original landscape which gave rise to the current capital city and are capable of fitting in its landscape planning. The main goal of

protection of the city-wide system of vegetation is to retain these spaces for the future as a source of calm, shade, and recreation. The aim of the conceptual measures is to evaluate the current unused spaces and brownfields and offer a meaningful use for these development areas.

Land use planning

Represents a potential tool for the implementation of adaptation measures. The State Land Office manages the proceedings on the basis of the Land Adjustment Act. The aim is to spatially and functionally organise land for better use, improving the functions of the landscape in terms of water regime, soil erosion, and biodiversity. The city will seek to initiate and apply for the process wherever such modifications can have an effect.



Dry polder „Čihadla“. The revitalization of the landscape consisted of backfilling the old capacitive riverbeds and substitution by new, nature-friendly, shallow, meandering shores. Small ponds were built, the banks of the ponds have been modified gradually and steeply, with regard to the possibilities of developing fauna and flora. PHOTO: WWW.PRAHA-PRIRODA.CZ, OCP MHMP

Manual for eco-friendly park management

The manual includes measures and processes of park management, residential and other vegetation in city management and the management of its organisations and city districts. These measures aid to increase local biodiversity, quality of ecosystems and resilience towards the effects of climate change and strengthen recreational and other values of this public space. The document is based on the Prague Public Space Manual.

PRIORITY 4

Increasing preparedness in climate-crisis management



Due to lack of methodologies, the city has difficulty evaluating its resilience.

The methodology of Klimasken, as one possible example, gives the city representants a clear overview of areas that require improvement. The city continuously increases its preparedness for moments of crisis.

Forming databases, analyses, mapping and methodologies for adaptation measures

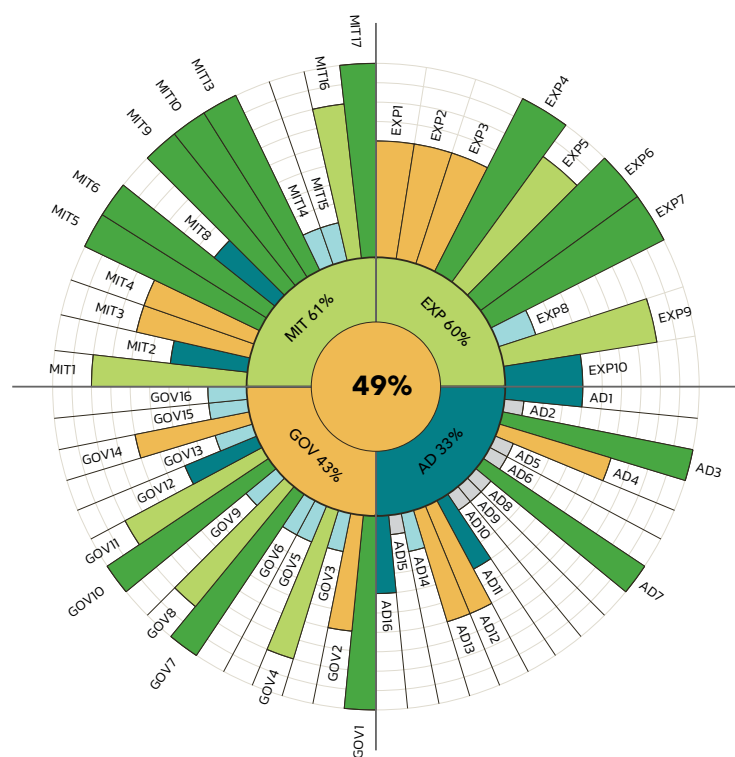
Continuing support for expanding the knowledge base is crucial for successful attainment of the Adaptation Strategy goals in Prague. It is therefore necessary to continue gathering useful data, create methodologies, concepts, and analyses of new opportunities on how to lessen the impacts of climate change and improve living conditions in the city.

Creating a functional system of indicators and a methodology for data collection in order to evaluate the effectiveness of adaptation measures

An indicator tool, composed of dozens of indicators, was created as part of the Implementation Plan 2020–2024. It allows the authors of specific measures and the project team to structure and assess the success of implementation of individual measures proposed by the Implementation Plan. For other users, it will aid in complex climate evaluation of the city, city districts, buildings, and city organs from the perspective of climate change and realised adaptation and reduction measures. The specific results for each indicated in preparedness of the Capital City of

Prague for climate change is available for download at <https://www.klimasken.cz/cs/model/35/vysledky>

The methodology of the Klimasken tool (methodological publication here) has informed also the 4 basic indicators of adaptation shown in the infographic on page 6. The baseline year for adaptation indicators in 2018. The target year is 2030. In the case of Indicator 1 (1.5 million newly planted trees), the target is intended as trees which will be planted in the Prague city are, city districts, city organisations, and other subjects administrating the management of vegetation. Indicator 2 (-28% share of drinking water for watering purposes) will be achieved by utilising rainwater as the main medium for watering of vegetation through the construction of accumulation basins and the Standards for Rainwater Managements which are currently underway. Currently, the share of drinking water used for watering is at 83%, the goal is therefore a reduction to 55%. Indicator 3 dictates the rise (+5%) in the share of public buildings managed by the city and city districts which have been renewed with the target of adaptation to climate change in comparison to the total number of buildings in the management of the city and its districts. Indicator 4 (+7 m²/1,000 inhabitants/year) foresees the establishment of blue-



Degree of certainty 57.1% / Data completeness: 87.5%

The output of the Klimasken tool which maps the readiness of the city for climate change aspects. SOURCE: WWW.KLIMASKEN.CZ

green infrastructure through transformation of paved surfaces. It does not concern revitalisation of existing natural features, additional planting, renaturation, or interventions in protected areas (natural heritage, ÚSES territorial system of ecological stability, etc.).

City safety

Prague should ensure that the city is safe, and its inhabitants are protected from natural catastrophes as part of the adaptation strategy measures. Prague is the most concerned with the dangers of floods and flooding. Aside from the preparation of methodologies and operational analyses, a key aspect are effective flood prevention measures on watercourses.

The topic of safety and crisis management closely relates to mapping of wells in the area of the capital city which could function as alternate sources of drinking water in cases of its scarcity.

Environmental education

The capital supports environmental education, monitoring, and scientific research. The aim of these “soft” projects is to increase awareness about related topics, communicate responsibly with the public, and connect the needs of the city with scientific research work. Educational projects should serve primarily to increase the interest of the public in topics of sustainable and healthy metropolis and provide an opportunity for every individual to actively participate.

The vision of the Regional Concept of Environmental Education and Awareness on the Territory of the City of Prague for 2025 is Prague where residents behave in eco-friendly ways and together create a city which is friendly to live in. The vision of the Capital City of Prague are residents who are aware of the importance of environmental and climate protection. Education concerning climate change and related phenomena is a branch of education which should not be overlooked, and which is becoming one of the thematic pillars of our generation’s education, as it deals with the aftermath of decisions



Methodology of Establishing community gardening and Living courtyards, issued by Environment Protection Department. SOURCE: OCP MHMP



The project of conversion of the former water reservoir tower in Praha-Vinohrady into modern educational centre Hydropolis that will be focused on the importance of water. SOURCE: HYDROPOLIS-PRAHA.CZ



The Prales eco-centre, founded in 2016 in Prague-Kbely, is one of the bases of ecological education in the city. PHOTO: JAKUB CIGLER ARCHITEKTI

made by governments and the society today and in the recent past.

For children and teachers, the Capital City of Prague is joining Prague Eco centres in developing and supporting educational programmes with focus on climate change adaptation.

For societies, communities, and city districts, as well as with their help, the city is preparing methodologies on environmental practice, such as Methodology on Community Gardens (2020) or Living Courtyards (2020). Other methodologies and manuals of rainwater management, and care for greenery are to follow. Through different outreach projects and campaigns out in the field, Prague communicates the issues of climate change and adaptation measures with the wider public, raises awareness and popularises the topic of climate change adaptation and preventing negative impacts of climate change.

Participation

In the future, the city should strongly focus on connecting information concerning climate change adaptation throughout Prague as a whole. The repository of projects must contain all projects realised by the city districts, departments of the City Hall, contributory organisations and others in the property portfolio of the Capital City of Prague, and in the future also projects of other individuals. Only through such methods will it be possible to utilise the potential and synergies between the realised measures. These connections will be operated by the Participative Information Centre for Adaptation which would provide the city districts, organisations, and also Prague’s inhabitants with the necessary support for organising activities or gaining grants and subsidies for the implementation of proposed measures. The information centre will function as a point for sharing information, best practices, and solutions.

HOW TO MEET THE GOALS

List of proposed measures

- 1 Revitalisation of parks, green spaces, and planting of greenery. The main aim of the measures is to lower the negative impact of extreme temperatures, heat waves, long-term droughts, and the impact of the urban heat island effect on residents.
- 2 Planting, renewal, and management of trees and tree avenues. The proposed measures focus on both the planting of trees, as well as on securing standards of care and renewal of tree avenues within the territory of the Capital City of Prague. Aside from the action plan on planting a million trees, other planting actions are expected on behalf of city districts, or organisations in city ownership or founded by the city of Prague. The key to success is to choose the right placement and species of tree, together with securing quality care and appropriate watering.
- 3 Establishment of water surfaces, wetlands, river and stream floodplains. Slowing of the surface water runoff from the landscape, lessening the negative impacts of flooding in urbanised spaces during periods of strong rain, are possible together with increasing the aesthetic and recreational value of the landscape. Originally straightened river channels are going to return into the surrounding meadows as meandering streams with water pools. A part of revitalisation is also the planting of forested areas, renewal of meadows and construction of dirt road frameworks, creation of small water surfaces. The aim of the measure is to accumulate water in the landscape, establish an ecologically positive state for the river courses, support biodiversity, increase green surfaces, and heighten the recreational potential of the city landscape.
- 4 Supporting recycling and reuse of wastewater for flushing, cleaning of public places, watering, and evaporation - cooling of the city. The use of constructed wetlands, wetland swales, roofs, or root system water treatment may be applied in the form of measures which utilise sewage wastewater in the public space. These nature-based solutions can lower the surrounding temperature using evapotranspiration, create green spaces which do not necessitate watering even in hot summer days, or produce clean water for local subsurface water of trees and lawns.
- 5 Gradual transformation of paved impermeable surfaces to permeable ones. Creating standards for rainwater management. As part of this measure, Prague is preparing a document titled "Standards for Rainwater Management" which should be binding for all new developer projects in the city area, as well as for all actors approving and managing these projects, or possibly as an important baseline for the so-called Prague building regulations.
- 6 The standards will include proposals for individual technical solutions tied to a typical place of realisation (apartment buildings, industrial areas, tramway rails, etc.). The aim of the measure is to prioritise the use of nature-based solutions as much as possible for the purposes of retaining rainwater in the Prague area, primarily through bioswales, retention and accumulation basins, transforming impermeable surfaces into permeable, realisation of green roofs, etc. to prevent direct surface water runoff into sewerage systems without its potential reuse (e.g., for watering purposes).
- 7 Adaptation measures on buildings (green roofs in combination with installation of renewable energy sources, and the setting up of vertical or green facades). The Adaptation Strategy also expects measures whose aim is a sustainable or climate friendly metropolis, and which emphasise the use of alternative sources of energy, as well as energy savings in the capital city's buildings. The measures include adaptation projects concerning the outer shell of buildings (materials, colours, green roofs, green facades, vertical greenery outdoors and indoors, shading, emphasis on ventilation, use of IT technologies for optimisation of heat comfort in buildings, PV installation, accumulation of rainwater, systems of grey water use, recuperation of air, etc.).
- 8 Establishment of vegetation components in the public space (green walls, mobile vegetation, care for courtyards). The use of greenery for facades, especially along linear infrastructure (free standing green walls, noise reduction facades, movable vertical greenery, live green constructions) aid in lowering the absorption and accumulation of solar radiation. Free standing green walls function as an adaptation measure against the urban heat island effect. They increase the value of surrounding property, increase biodiversity, and lower the noise stress in cities. They can utilise rainwater and have a large ratio of evapotranspiration.
- 9 Establishment of misting devices, water fountains, and water features on the streets. In order to allow for an easier stay in the metropolis' street spaces during heat waves, the implementation standards for misting devices have already been compiled and a concept for new drinking fountains has been approved. The standards were set so that these features may be easily connected to pre-existing hydrants and therefore make the implementation easier for interested parties from city districts to install in their areas. A part of these solutions is also the servicing and management of these features by the city.
- 10 Supporting sustainable agriculture and establishment of community gardens. Together with the support for the creation and revitalisation of sustainable agriculture and community gardens, the overall potential of green infrastructure features is rising, the microclimatic conditions of the city are improving, biodiversity of the agricultural landscape is strengthened, and the ecological value of the area is rising.
- 11 Agricultural lands in city ownership have until recently been leased out to tenant farmers who used the soil primarily for intensive agriculture. In 2019, Prague terminated all pre-existing contracts and introduced a new process where the renters are responsible for keeping to eco-friendly agricultural standards - alternate planting following crop rotation plans, ensuring the sowing of catch crops, correct methods of ploughing, limited use of chemicals when tilling the soil; use of organic fertilisers; individual single crop fields now cannot be larger than 5 ha, or must be divided using dirt roads, boundaries, hedgerows, and tree avenues.
- 12 In relation to care for courtyards and community gardens, the Methodology on community gardens and the Living Courtyards methodology are currently planning new steps towards their realisation and operations.

Implementation and Monitoring

In order to realistically achieve the set-out standards, it will be necessary for the city (represented by its elected organs) to approve the following measures of personal, economic, and processual character.

Establishing a coordinator/managing entity

The first crucial step has already been taken, as starting from 1 September 2020 Prague became one of the first cities in the country to establish a separate **department of the Energy Manager of the Capital City of Prague** (“EM Department”) in the organisational structure of the town (city) hall. This department will be responsible for monitoring the implementation of the plan and conducting an evaluation of its successful fulfilment in set periodic intervals (every two years).

As part of its agenda, the EM Department will also provide management and coordination during the preparation of investment proposals planned by the city which could have an impact on fulfilling the climate pledge. The EM Department will also be a point of feedback on relevant decisions related to these proposals before their discussion and approval by the elected city organs.

Aside from the Energy Manager of the Capital City of Prague, all departments of the city hall, city organisations (both contributory organisations and commercial companies), as well as city districts and organisations founded by them, should appro-

priately participate in the implementation of the Climate Plan.

Introducing a system of energy management

Another important step is to introduce an effective **energy management system (EnMS)**, under the control of the Climate Plan coordinator (EM Department). The system should be put together following the ČSN EN ISO 50 001 regulation (and be certified accordingly), and over time include all areas of energy use of the city, city districts, as well as city organisations. The system should be automated as much as possible (at the least by collecting data from electricity, heat, and gas providers, and optimally on the level of selected meters and temperature sensors) and allow for a thorough monitoring of energy demands of the city. From these, it is relatively easy to assess the carbon footprint and follow its changes.

A professionally outlined “EnMS” system will allow to identify wasteful or excessive energy uses, as well as optimise the costs related to energy purchases. It will further lead to a better care for buildings and improvements in investments on behalf of the city during renewals of the current building stock. All of the EnMS system data should be owned directly by the city (City Hall), which will ensure good coordination of the Climate Plan’s implementation. With well-mapped energy flows, it will be easier to begin monitoring the carbon footprint of the city and inform the relevant city bodies of its development.

The so-called target values should implicitly respect the climate pledge of the city and present a continuous reduction of energy demand or an increase in the shares of energy covered by low and zero emission sources.

In support of easier accounting, it would be beneficial to simultaneously create **synthetic accounts** as part of budget guidelines for individual forms of energy (heat, gas, electricity, motor fuels) in the respective budget areas, even as part of the core budgets of individual city districts and organisations.

Establishing a climate fund for the city

A third significant measure is the establishment of a **“city climate fund”** the purpose of which will be to aggregate resources which can be used to finance the measures of the Climate Plan.

It will also serve to transparently inform the public about the amount of financial resources that have been, or will be, spent each year by the city on the Climate Plan’s implementation. The total amounts collected should reach the values that the Climate Plan anticipates for each year (see [Appendix 2](#)).

The exact concept of the fund will be clarified in the process of proposal drafting, which will then be submit-

ted to the city authorities for approval. The fund may function both as an annual part of the budget (again based on synthetic accounting) or as a specific financial instrument which will be open to donations from third parties. Inspiration can be taken from different models of “city climate funds” utilised by world cities.⁴⁵ A future incoming resource for the fund should also be the savings created by the implementation of some of the Climate Plan measures, verified through the complete EnMS system administered by the EM department, therefore leading to reduced demands on the city’s budget.

New regulations for procurement of products and services

The last important measure lies in updating the standards used by the city and its organisations to regulate purchase of selected (and carbon footprint involving) products and services. These new regulations should take into consideration the carbon footprint (CO₂ emissions tied to the specific service) or energy demands and lead the city’s and city organisations’ suppliers towards more sustainable solutions.

Establishing a defined CO₂ emission threshold and setting it as an advantage in selection criteria seems to be a beneficial option when deciding about:

⁴⁵ See C40 Cities Good Practice Guide – City Climate Funds. November 2016. Sustainable Infrastructure Finance Network (<https://www.c40.org/cities>)

- Energy purchases
- Construction of new buildings and renewal of the city's current building stock
- Purchase of new transport vehicles or any services connected to transport
- Selecting suppliers of other purchased services (environmental and energy standards)

In the case of energy purchases, it is appropriate to define regulations for all centralised and decentralised purchases (electricity, gas, heat), as this will motivate suppliers to search for more environmentally friendly sources. At the same time, it is advantageous to set requirements for the proportion of electricity to be sourced from low- and zero-emission sources which are yet to be constructed (by providing evidence of established PPA contracts initiating their construction).

An important aspect for buildings is the evaluation of emission footprint of newly built structures in the context of their lifecycle, i.e., including the manufacturing and demolition phase.

Utilising external sources of financing

It is crucial to continuously conduct market research of sources of accessible external funding and utilise them to their maximum potential. A basic analysis of support programmes had already been conducted as part of the preparation of the Climate Plan (see [Appendix 1](#)).

It is therefore appropriate for the organisational actors of the city (primarily EU Funding department of the Prague City Hall) to conduct monitoring and coordinate steps with the aim of scheduling appropriate timings for the preparation of projects which could be given funding from such subsidy programmes.

Continuous monitoring of outcomes

It will be necessary to evaluate the obtained results. The specifics of this monitoring are proposed in alignment with the methodological outline of SECAP plans for the period of every two years, including an overall energy

and emission balance drawn up each time (following a set example). Concurrently, an analysis of the outcomes of already implemented steps will be conducted using monitoring indicators.

The responsible actor in producing these interim reports will be the **EM department**.

International climate partnerships for sharing examples of good practice

By accepting the climate pledge, Prague positioned itself among a group of cities which agreed to implement the ambitious goals of the Paris Agreement on a local level. Three quarters of the world's population live in cities and the trend of migration into cities is still ongoing. The EU anticipates that by 2050, the share of city inhabitants will be around 85%. Cities are centres of technological innovation and decarbonisation strategies and therefore also leaders in promoting a carbon-free future.

There are a number of initiatives joining climate-responsible cities. Prague is a member of **the Covenant of Mayors**⁴⁶, a European initiative introduced by the European Commission after approving its first climate-energy package in 2008. The initiative includes more than 10,000 cities from 61 countries, accounting for 334,000 residents.

C40 cities⁴⁷ connects 97 world metropolises representing more than 700 million inhabitants – a quarter of the world's economy. European cities are represented by Amsterdam, Barcelona, Berlin, Copenhagen, Lisbon, London, Madrid, Oslo, Paris, Rome, Stockholm and others.

Race to Zero⁴⁸ is a coalition of 471 cities, 23 regions, 1,675 business owners, 85 representatives of large investors and 569 universities. The initiative was created at COP25 in Chile, and it will be a major partner in November 2021 at COP26 in Glasgow.

CNCA (Carbon Neutral Cities Alliance)⁴⁹ connects 19 climate ambitious cities trying to achieve carbon neutrality in the shortest time possible.

The European Commission (DG Research & Innovation) set the initiative **Proposed Mission: 100 Climate-Neutral Cities by 2030 – By and For the Citizens**⁵⁰. This is a completely new path based on the assumption that current traditional ways of governance will be replaced with more strategic advocacy for long-term climate investments. The selection of 100 cities will be based on their climate ambitions and commitment, their opportunities, and the involvement of the local population.

Aside from Prague's potential involvement in these or other existing alliances, it is desirable and beneficial for the city to join climate partnerships with selected metropolises and therefore allow for direct collaboration in the field of climate politics. The aim is to provide opportunities for expert dialogue and exchange of good practices for authors of climate strategies, those responsible for their implementation, and politicians responsible for mitigation and adaptation to climate change.

As of now, beneficial partnerships have been identified with Berlin, Copenhagen, Vienna, and Taipei. Exchange of information is also ongoing with the city administration bodies of the V4 cities – Bratislava, Budapest, and Warsaw. Further expert cooperation will depend on the openness and willingness of these and other cities. A good opportunity for discussing such partnerships is likely to arise at the conference of parties to COP26 in November 2021 in Glasgow, which will provide space for exchange of information and practices in formulating and implementing climate policies.

The preliminary conditions for establishing climate partnerships with other cities are the following:

1. The cities have approved climate commitments which align with the recommendations of the Intergovernmental Panel on Climate Change (IPCC) Special Report of 2019⁵¹.
2. The cities commit to mutual support in efforts to fulfil the aims of the climate pledge.
3. The cities are prepared to share their policies, strategies, experience, examples of good practice, methods of leadership and other attributes of climate politics in the form of cooperation between experts, civil servants and politicians through webinars, workshops, and other smart online platforms ("Learning by Sharing").
4. The cities will create a space for open partnership in exchange of expert information through informal consultations on all levels.
5. The cities will actively create opportunities for joint participation in climate-related projects and programmes.
6. The cities will inform each other about the involvement of business and other partners in their climate-forward efforts.
7. The cities will cooperate on key climate summits.
8. The climate partnership will be free of demands on the cities' budget, except for covering the costs of its own politicians, experts, and officials when connected with the partnership.

⁴⁶ See C40 Cities Good Practice Guide – City Climate Funds. November 2016. Sustainable Infrastructure Finance Network (<https://www.c40.org/cities>)

⁴⁷ C40 Cities Good Practice Guide – City Climate Funds. November 2016. Sustainable Infrastructure Finance Network. (<https://www.c40.org/cities>) [45]

⁴⁸ United Nations Climate Change, Race to Zero Campaign, <https://unfccc.int/climate-action/race-to-zero-campaign> [46]

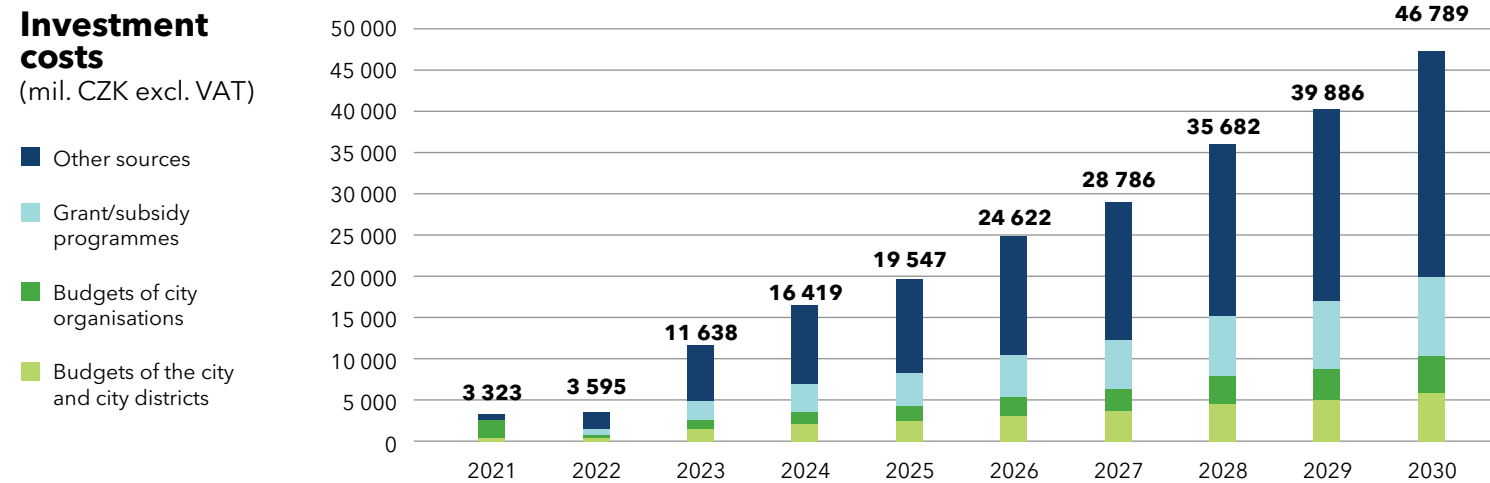
⁴⁹ Carbon Neutral Cities Alliance, <https://carbonneutralcities.org/cities/> [47]

⁵⁰ Proposed Mission: 100 Climate-neutral Cities by 2030 – by and for the Citizens, https://ec.europa.eu/info/publications/100-climate-neutral-cities-2030-and-citizens_en [48]

⁵¹ Global Warming of 1.5 °C https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf [49]

Financing the Plan

FIGURE 18 Expected process of the implementation of the Climate Plan from the perspective of costs and their financing



It will be necessary to plan the implementation of the plan in phases, as the adverse impact of the COVID-19 pandemic has been reflected in the city's budget, as well as in many other areas.

As a result, it appears more reasonable to first **focus on those measures which have the potential to be fully self-financed** before monitoring the overall costs of the Climate Plan's implementation which, while large in absolute numbers, are reasonable for their scope.

Priority measures (economically viable)

This condition can be fulfilled by those measures, for which the initial costs can be co-financed from subsidy programmes and/or those which will be able to draw from national financing subsidies after their implementation. Due to either type of financing aid and the fact that CO₂ reducing measures tend to lead to savings on operational and energy costs (due to reduction in energy demands or their substitution with a more eco-

nomical source), it is possible to obtain more financial support during their lifecycle than the initial costs (invested), when considered from the perspective of the city (or, more generally, the investor). **In other words, the city would be acting non-economically if it did not utilise these opportunities.**

To fulfil these premises, each investment proposal which will be included as part of the Climate Plan for Prague should be **subjected to an economic analysis with a required positive result** (evidenced by a standard financial indicator such as net present value) in order to be approved by the elected city representatives.

Based on the preliminary analysis of prepared national and European grant programmes which will become available within the next decade and which will be accessible for the purposes of supporting the implementation of Czech and EU aims (see [Appendix 1](#)), it seems fitting to first focus on the measures

listed in the Executive Summary, p. 16; some of them will be formed by a range of repeating events.

Other measures

Other measures proposed by the plan may be implemented in a longer time frame and at a pace which will be dictated by available programmes of financial support, the development of prices of energies, and other factors.

It is likely that by the end of this decade, the carbon intensity of products and services will be much more internalised than today, and technological advancement will improve the economic viability of some measures to a degree that will make them economically advantageous.

For this reason, it is necessary for responsible actors in city administration (EM department, EU Funding department) to monitor the market developments and react to such changes with appropriate projects.

Financial plan for the implementation of the Climate Plan

A preliminary financial plan was created for the period of 2021 to 2030, with the aim to provide long-term planning concerning the financial resources required for the ongoing implementation of the Climate Plan and its individual measures.

The graph on the opposite side provides a brief overview of this plan. It is divided between the individual sources - the city budget, budgets of city districts and city organisations, intended funding from grant programmes, and finance invested by other actors whose interests lie in the city's sphere (mainly households, but also companies and energy suppliers).

The starting point for its preparation were individual financial plans for each of the measures, which are listed in separate action sheets in Appendix 2.

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APPENDIX 1

Financial Support Tools

Aside from financing for lowering CO₂ emissions from the PCH budget, the new programming period 2021-2027 offers the Capital City of Prague the opportunity to utilise new operational programmes, especially the **Operational Programme Environment (OPE)**, **Integrated Regional Operational Programme (IROP)**, **Operational Programme Transport (OPT)** and a programme financed from the proceeds of emission allowance permits called **New Green Savings (NGS)**.

In addition to these standard cohesion policy instruments, the political decisions of the city leadership to substantially reduce CO₂ emissions (and other related pollutants) meet the EU's goal to become climate neutral. The new development strategy, the goal of which is the transformation of the EU into a modern, competitive economy, is set out in the **European Green Deal**⁵². A part of the investment plan for the implementation of the European Green Deal are also new financial tools.

The EU's Multiannual Financial Framework 2021-2027 foresees a 30% allocation for climate protection across the EU budget.

Modernisation Fund

One of the most viable options of accelerating the investments into Prague's climate measures is the **Modernisation Fund**. It is a financial instrument⁵³ which is set up in 10 lower-income EU member states, among which the Czech Republic falls with the current methodology of calculations. EU member states will contribute 2% of all income from emission

allowance permits EU ETS in 2021-2030 towards financing the core of the Modernisation Fund. The Ministry of the Environment has also proposed in the adopted amendment to the Act on Trading in Greenhouse Gas Emission Allowances that the so-called derogation and solidarity allowances will be used as sources for the Fund. The estimate of the total budget of the Modernisation Fund for the next 10 years varies according to predictions of the price of emission allowances. With an allowance price of 30 €/tonne, the total budget should reach around 150 billion CZK.

The Capital City of Prague did not feature in the original proposal of eligible applicants for support from the Modernisation Fund. By initiating dialogue with the Ministry of the Environment and the international consortium ICF and Enviros, employed by the European Commission, it was possible to gradually persuade the administrators of the Modernization Fund of the Ministry of the Environment that Prague possesses a significant potential to contribute to the climate goals of the Czech Republic (recently the Prime Minister at the European Council voted in favour of increasing the common European target of reducing greenhouse gas emissions from 40% to 55% by 2030). An important supporting argument for the inclusion of Prague among the eligible applicants was the adoption of the climate pledge. The Committee on Sustainable Energy and Climate presented proposals and state of individual projects in the ICF questionnaire survey and Prague was subsequently recognised as eligible. A representative of

the Committee was subsequently invited to join the Modernization Fund preparation platform.

In a general programming document, the Ministry of the Environment proposed 9 areas of support,

of which the following 8 programmes are relevant for Prague and its organisations (DPP, PRE, Pražská teplotárenská, etc.):

Number	Programme name	Abbreviation	Focus of the programme
1	Modernization of thermal energy supply systems	HEAT	Support for projects utilising RES and low-carbon sources primarily for heating, for changing fuel bases and for the modernisation of thermal energy distribution.
2	New renewable sources in energy	RES+	Support for new non-fuel renewable energy projects.
3	Improving energy efficiency for businesses	ENERG	Support for installations and measures to improve energy efficiency and reduce the production of greenhouse gases in businesses, beyond the EU ETS.
4	Modernization of transport in the private sector	TRANSCOM	Support for business owners in the purchase and acquisition of alternative fuel vehicles and non-public infrastructure.
5	Modernization of public transport	TRANSGOV	Project support for public bodies, publicly owned enterprises, public entities and public non-business entities, as well as businesses with a public service obligation, for the acquisition of: (a) alternative fuel vehicles for public transport, (b) public transport infrastructure.
6	Energy efficiency in public buildings and infrastructure	ENERGOV	Support for comprehensive measures to improve energy efficiency and the use of renewable and low-emission sources in public buildings, government buildings and public infrastructure.
7	Community energy	KOMUNERG	Supporting open energy communities established to meet their energy needs (their main purpose not being profit).
8	Modernization of street lighting systems	LIGHTPUB	Support for the renewal and modernisation of street lighting systems with the potential of installing innovative elements.

Innovation Fund

The European Commission Innovation Fund has already published its first open call for large projects (above 7.5 mil. EUR) which include breakthrough innovations in low-carbon technologies. The support can be up to 60% of additional costs connected to the implementation of the specific innovative tech-

nologies. Projects of all EU countries compete for funding in the selection process. Realistically, the closing date for applications for a project presented by the city of Prague would be the second half of 2021. The expected allocation for a second call will be identical, i.e., 1 billion EUR and 8 million EUR for technical assistance and project preparation.

⁵² https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_cs [50]

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The fund will be operating with approximately 10 billion EUR in for 2020–30, which will be released annually.

The authors of this text are of the opinion that a major innovation potential lies in the project of utilisation of low-potential heat from the treated water produced by the Central Wastewater Treatment Plant (ÚČOV) with the potential to supply 80 to 90 MW of heat into the distribution system for a city district of an average size. The obtained heat would also be used to desiccate wastewater treatment sludges before their use in energy production by incineration in the city waste incineration plant. Reviewing the parameters of this project and its high potential to be replicated elsewhere in other EU metropolises could lead to a major reduction in greenhouse gasses by utilising otherwise unused energy.

ELENA

The ELENA project (European Local Energy Assistance) focuses on assistance during project planning and preparation. The programme supports the preparatory phase of projects connected to energy savings and installations of renewable energy sources by providing a non-repayable subsidy.

The goal of PCH should be to utilise this subsidy opportunity for a systematic preparation of renovations of city buildings (primarily non-residential, but eventually also residential). Under the terms of the programme, up to 90% of the eligible costs associated with the preparation of these measures on municipal buildings can be financed, provided that the projects are developed to the stage of launching the tendering procedure for their construction within 3 years of signing the contractual relationship with the EIB. An application for a preliminary amount of 50–60 mil. CZK is planned to be submitted for the next 3 years with the intention to follow up with investments of 1 to 1.5 billion CZK. In view of the expected approximately 6 billion CZK in the Modernisation Fund for this type of measure, staffing constraints in project preparation rather than finan-

cial resources will be the limitation and need to be addressed.

It is important to note that the ELENA programme is a tool which will allow the Energy Manager department to self-finance most of their activities.

Most attention will be focused on school buildings, playgrounds, cultural and social-healthcare facilities with the aim to introduce renewable energy sources and sustainable heat sources, such as PV systems or heat pumps, into their energy management. Alternatively, economically driven measures to improve the energy efficiency of buildings will be introduced, with potential use of the EPC method if its application is found to be beneficial.

The request of the city of Prague to join the programme had already been made and it is currently up to the energy manager to prepare a full application and submit it after approval by the Prague City Council and the Prague City Assembly.

Operational Programme Environment (OPE)

The new OPE focuses on supporting effective use of energy sources, sustainable water management, transition towards the circular economy, energy efficiency, adaptation to climate change, strengthening green infrastructure in urban environments, and reducing pollution. Its goal is also to contribute to resolving environmental and climate issues on European and global levels.

The programme is multi-funded - part of its activities are financed from the European Regional Development Fund (ERDF) and part from the Cohesion Fund (CF). At the moment, activities funded by the CF are available to Prague.

The following activities are listed in the most recent version of the programme document:

- 1.3 support for adaptation to climate change, risk prevention and resilience to disasters - activities aimed at preventing and increasing resilience to floods, landslides and droughts, establishment and restoration of public urban greenery, implementation of measures for rainwater use, incl.

green roofs, renewal of forest covers, and actions aimed at raising awareness of climate change will be supported.

- 1.4 support for sustainable water management - activities leading to an improvement in surface water and groundwater quality, as well as actions leading to improvements in drinking water supply for inhabitants.
- 1.6 strengthening biodiversity, green infrastructure in urban environments, and reducing pollution - a wide range of actions aimed at management of protected areas, natural habitats, and rare species, as well as improving air quality and reducing the number of contaminated sites. In the field of air quality, support will be given to actions supporting replacements or renewals of stationary sources of air pollution, including the implementation of additional technologies and changes in technological processes, or the acquisition and modernisation of systems for assessing and evaluating air pollution levels and related meteorological aspects, as well as the acquisition and modernisation of systems for archiving and processing air pollution data.

Integrated Regional Operational Programme (IROP 2)

The new IROP 2 programming document was approved by the Government of the Czech Republic in 2020 and is currently undergoing a comment procedure process within the European Commission. The programme covers the CZ01 NUTS area, i.e., only certain areas of Prague.

The Ministry for Regional Development has expanded the current IROP programme to also include the topic of revitalisation of cities and towns, for which Prague may be an eligible applicant, together with the action - "Low-emission and emission-free vehicles including filling and charging stations for public transport".

The action "Support for sustainable multimodal urban mobility" is included in Priority 2 as an instrument of the policy objective "A low carbon and greener Europe".

The IROP 2 managing authority is kept informed about the interest of the Capital City of Prague, i.e., the Prague Public Transit Company (DPP) to gradually replace diesel buses with battery-powered hybrid trolleybuses, which may be charged during uphill journeys from electric traction. An alternative to the introduction of hybrid trolleybuses is increasing the share of electric buses and hydrogen-powered vehicles in the DPP fleet. Prague has already secured an allocation for these projects from the IROP programme.

Part of the plan for the development of hydrogen mobility within the Prague public transport network is also the construction of a facility to produce pure hydrogen from PV, supported by hydrogen produced on the basis of natural gas if necessary. Savings directly in public transport vehicles are also being considered through placements of PV panels onto their roofs.

The aim is to replace 900 diesel buses with an average range of over 200 km/day. The incurred CO₂ savings are expected to reach up to 70,000 tonnes CO₂/year.

The modernisation fund allows for investment subsidies of 70 to 80% of the overall invested amount which ensures good returns, not to mention the benefits in terms of reduced local pollutant emissions along the bus routes.

An agreement between the Ministry of Regional Development and the Ministry of the Environment envisages both programmes as complementary - as soon as the IROP allocations are exhausted, the Modernisation Fund will begin financing analogous measures.

Operational Programme Transport

The programme falls under the Ministry of Transport and is divided into three main areas:

- European, national, and regional mobility
 - National road mobility ensuring connectivity to the TEN-T network
 - Sustainable urban mobility (and alternative fuels)
- The entirety of the urban mobility area will be fi-

nanced through the ITI tool, where a new Integrated Strategy for the Prague Metropolitan Area is currently being developed under the leadership of the PCH. This is an action for which the PCH is an eligible applicant.

The construction of new tramway and trolleybus lines will be given priority for support from this programme, as is regularly discussed between the PCH, DPP and the Ministry of Transport. This section complements the activity for the acquisition of battery-powered trolleybuses described in the IROP chapter.

The following actions will also be supported:

- Development of infrastructure for electromobility and other alternative fuels (hydrogen, LNG), primarily in implementing infrastructure for publicly accessible filling and charging stations.
- Converting the most frequented bus lines to electric traction and completing long-planned lines to high-density locations.

CEF - Connecting Europe Facility

The CEF is an EU programme that was already in place in the current period (2014-2020) and is directly managed by the European Commission. It represents another funding option for projects in the transport, energy, and telecommunications sectors. It is primarily aimed at development of infrastructure in these areas, particularly projects with a broader European dimension. The coordinator is the Ministry of Transport.

In the field of energy, support is given to projects which lead to cross-border integration of the internal energy market, increase the security of energy supply within the EU, and integrate renewable energy into the transmission system. Funding is also directed towards the development of smart electricity networks⁵⁴.

This instrument imposes significant pressure on the quality and preparedness of the projects with a rigorous selection process, as the competition in-

cludes all projects submitted from across the European Union. Not much information is available on this instrument for the next programming period, and it has not been subject to negotiation. However, discussions are taking place at the European level through an initiative of the V4 capital city mayors. The aim is to enhance the responsibilities of regional and local authorities so that they become an integral part in the submission and assessment of proposed projects.

Recovery and Resilience Fund

The Recovery and Resilience Fund (RRF) is broken down into grants and loans, with the Czech Republic expected to be allocated 182.1 billion CZK in the form of grants and another approximately 400 billion CZK available for loan from the European Union. A condition for utilising the RRF resources is the preparation of a National Recovery Plan, currently coordinated by the Ministry of Industry and Trade of the Czech Republic, which is subject to approval by the European Commission.

The national plan is to be drafted for 2021-2023, and all commitments must be made by the end of 2023. The Czech Republic will then continue to receive payments scheduled under this plan until 2026. The draft version has not yet been approved by the government, but it has been forwarded to the European Commission. The City of Prague is currently commenting on the government's "Recovery Plan" and is negotiating with the relevant ministries over this crucial financial instrument. One of the main pillars focuses on infrastructure and green transposition.

An allocation for the Capital City of Prague is currently being negotiated from the Clean Mobility Development action. The city therefore expects to acquire approximately 2.9 billion CZK for the purchase of vehicles (electric buses and hybrid vehicles for public transport), as well as the construction of relevant charging infrastructure.

In regards to the action for the renovation of buildings with the aim to reduce their energy consumption, the city put forward an argument for the implementation of energy-saving measures currently concerning the renewal of state-owned buildings to be applied to all public buildings within the City of Prague territory.

A major advantage of the RRF is the potential of up to 100% financing from European funds, compared to, the upcoming programming period, where clean mobility for Prague has also been proposed in IROP 2. As a more developed region, however, the co-financing potential reaches only up to 60% (with only 40% covered by European funds).

APPENDIX 2

Individual Sheets for the Measures of the Climate Plan Leading to a Significant Decrease in CO₂ Emissions

In accordance with the methodological guidelines for the preparation of SECAPs (Sustainable Energy and Climate Action Plans), a more detailed sectoral breakdown has been made for measures with a quantifiable positive effect on reducing the production of countable CO₂ emissions (municipal property and city district properties; housing and building stock; tertiary sector; street lighting, industry; energy (production and distribution of electricity and heat); municipal vehicle fleet; public transport; private and commercial transport). The breakdown is shown in the following tables.

For each of these measures, a plan for possible implementation steps for the period of 2021-2030

was drawn up in the form of individual project sheets, which detail the long-term costs and benefits.

It should also be noted that the CO₂ reduction measures are complementary to actions expected to be implemented in the reference scenario of development. Their impact on the city's carbon footprint has been quantified at approximately 1.1 million tonnes of CO₂ relative to the baseline of 2010. This is due to the expected gradual decline in electricity produced from coal having a significant impact on the decrease in specific CO₂ emissions from the electric power supply system (see [Chapter 3, Carbon footprint of the city](#)).

54 <http://www.dotaceeu.cz> [51]

TABLE 2 List of measures leading to a decrease in CO₂ emissions, as proposed in the section “Sustainable Energy and Buildings”

Sustainable energy and buildings		
<p>Area 1 – Energy-saving measures for the property of CP and CD</p> <ul style="list-style-type: none"> → Improving heat-insulation properties of the outer shell of buildings → Installation of power ventilation in schools → Modernisation of heat exchange stations and management of the heating systems in buildings connected to district heating → Replacing heat sources using natural gas with more efficient options (condensation boilers) → Installation of a system of remote operated TRV valves on radiators (so-called IRC system) → Replacement of fluorescent lighting with more efficient LED options in all schools, as well as in other larger city-owned buildings → Introducing energy management and smart monitoring → Complex EPC projects – utilising a combination of the above-described measures in other buildings → Installation of sources of heating and cooling based on the principle of heat pumps (partially utilising waste heat in cooling) → Installation of solar power (photovoltaic power stations) → Installation of combined sources of electricity and heat in the form of cogeneration units using natural gas 	<p>Area 2 – Housing and building stock</p> <ul style="list-style-type: none"> → Improving heat-insulation properties of the outer shell of apartment buildings → Improving heat-insulation properties of the outer shell of residential housing → Modernisation of heat exchange stations and management of the heating systems in buildings connected to district heating → Replacing heat sources using natural gas with more efficient options (and introducing more effective management of the heating system) → Replacing coal-fired boilers with natural gas and heat pumps (and introducing more effective management of the heating system) → Replacement of fluorescent lighting with more efficient LED options → Replacement of electrical appliances (white goods, consumer electronics) → Replacement of heating appliances with more efficient ones (heat pumps, heaters with lower heat losses) → Installation of heat pumps in apartment buildings → Installation of heat pumps in residential housing (also to be used in cooling) → Introduction of smart electrometers → New residential housing construction in the so-called passive standard and carbon neutral buildings → Installation of solar power (photovoltaic power stations) → Installation of combined sources of electricity and heat in the form of cogeneration units using natural gas in apartment buildings 	<p>Area 3 – Tertiary sector (except municipal buildings)</p> <ul style="list-style-type: none"> → Improving heat-insulation properties of the outer shell of buildings → Modernisation of heat exchange stations and management of the heating systems in buildings connected to district heating → Replacing heat sources using natural gas with more efficient options (condensation boilers) → Installation of a system of remote operated TRV valves on radiators (so-called IRC system) → Replacement of fluorescent lighting with more efficient LED options → Replacement of heating appliances with more efficient ones (heat pumps, heaters with lower heat losses) → Introduction of energy management/smart meters → Complex EPC projects – utilising a combination of the above-described measures in other buildings → Installation of sources of cooling based on the principle of heat pumps (partially utilising waste heat in cooling) → Installation of solar power (photovoltaic power stations) → Installation of combined sources of electricity and heat in the form of cogeneration units using natural gas in apartment buildings
<p>Area 4 – Street lighting</p> <ul style="list-style-type: none"> → Replacing public street lighting with more efficient LED types → Utilising smart regulation of light intensity for higher energy savings 	<p>Area 5 – Industry</p> <ul style="list-style-type: none"> → Replacement of fluorescent and other types of lighting with more efficient LED options → Various cost-saving measures in production technologies and related technical equipment → Installation of solar power (photovoltaic power stations) 	<p>Area 6 – Energy (production and distribution of electricity and heat)</p> <ul style="list-style-type: none"> → Utilising low-potential heat from the Central Wastewater Treatment Plant (in conjunction with co-generation using natural gas) → Combined production of electricity and heat in district heating sources – gas heating plants → Replacement of heat production and distribution from coal as part of the metropolitan district heating system → Increasing the processing capacity of ZEVO Malešice (from approx. 240,000 tonnes in 2010 to 350,000 tonnes in 2030) → Introducing a partial conversion of waste sludge gases from ÚČOV Prague into biomethane – support of (bio)CNG vehicles → Use of wastewater treatment sludges for energy purposes → Utilising the pressure gradient in the gas network for electricity generation

<ul style="list-style-type: none"> → Solar photovoltaic power stations installed on surfaces other than the outer faces of buildings → Lowering the heat loss in heat production and distribution in the district heating network → Lowering the losses of natural gas (including greenhouse gas methane) during its distribution and end use → Reducing the carbon footprint of electricity distribution → Supporting the construction of new electric power plants utilising renewable sources of energy outside of the Prague area by long-term purchases of their energy through PPA contracting

TABLE 3 List of measures leading to a decrease in CO₂ emissions, as proposed in the section “Sustainable Mobility”

Sustainable mobility		
<p>Area 1 – Municipal vehicle fleet</p> <ul style="list-style-type: none"> → Conversion of existing vehicles owned by the city and its organizations which use compressed natural gas to advanced fuels – biomethane – and further increasing their numbers → Gradual acquisition of battery-powered electric vehicles (including the possible use of hydrogen) for the municipal vehicle fleet, city-established organisations companies 	<p>Area 2 – Public transport</p> <ul style="list-style-type: none"> → Development of electromobility in bus public transport (beyond the planned development scenario) → Increasing the performance of railway public transport on Prague’s territory (in connection to the measures concerning the construction of metro line D and planned tramway lines) → Development of suburban and metropolitan railway as part of the integrated public transport (other measures connected to the construction of new lines and increasing the capacity of current ones) 	<p>Area 3 – Private and commercial transport</p> <ul style="list-style-type: none"> → Increasing fees in motor transport → Development of bicycle transport and walking → Development of electromobility in the integrated public transport network (beyond the planned development in BAU) → Conversion of the existing vehicles of city organisations to the use of advanced biofuels – biomethane – and further increasing their numbers → Partial electrification of boat transport on Prague’s territory supported by construction of charging infrastructure and other motivational and regulatory tools. → Supporting the transformation of air travel towards sustainability

TABLE 4 List of measures leading to a decrease in CO₂ emissions, as proposed in the section “Circular Economy”⁵⁴

Circular economy		
<p>Area 1 – Utilising biological waste for the production of biomethane</p> <ul style="list-style-type: none"> → Production of advanced biofuels – biomethane – from municipal bio-waste and its use as a transport fuel (especially in the Prague Services fleet) 		

⁵⁴ Applying the principles of the circular economy to city operations has far-reaching implications for reducing CO₂ emissions. This table will be supplemented over time with the quantification of CO₂ savings based on the measures mentioned above in Chapter 6. For the moment, only the area relating to the use of biomethane has been included in the summary of the benefits of the individual measures due to the availability of data and methodology comparable with the areas of sustainable energy and mobility.

Project team



Martin Bursík
Committee on Sustainable Energy and Climate, Chairman



Tomáš Voříšek
Committee on Sustainable Energy and Climate, Team Member



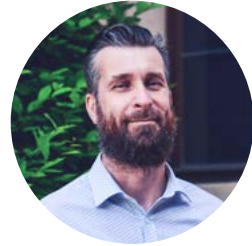
Vojtěch Vosecký
Committee on Sustainable Energy and Climate, Team Member



Kateřina Schön
Committee on Sustainable Energy and Climate, Team Member



Daniel Vondrouš
Committee on Sustainable Energy and Climate, Secretary of the Committee



Jaroslav Klusák
Energy Management Department, Head of Department



Tereza Líbová
Climate Adaptation Specialist, Environment Protection Department



Jaroslav Mach
Transport Development Department, Head of Department



Alena Vondroušová
Secretariat of the Deputy Mayor for the environment, infrastructure and technical equipment of Prague Mr. Petr Hlubuček

Frequently used acronyms

- BAU Business as usual - the reference scenario, i.e., without the measures proposed in the climate plan
- BEI Baseline Emission Inventory
- BRKO Biologically degradable household waste
- CO₂ Carbon dioxide
- DPP Prague Public Transit Company, a. s.
- DtD Door to Door system, i.e., placement of waste collection bins in residential courtyards
- EM Energy Manager (Energy Manager department as part of the Environmental Protection department within PCH)
- EnMS Environmental Management System
- EPC Energy Performance Contracting
- PV Photovoltaic power station
- CCP Capital City of Prague
- IPR Prague Institute of Planning and Development
- MEI Monitoring Emission Inventory
- RES Renewable Energy Sources
- PAYT Pay as You Throw - payment for waste collection based on actual amount produced
- PPA Power Purchase Agreements - type of contracts
- PRE Pražská energetika, a.s. (Prague Energy Company)
- PSAS Pražské služby, a.s. (Prague Services)
- PREC Prague Renewable Energy Community
- SECAP Sustainable Energy and Climate Action Plan
- SKO General household waste
- SZT District heating supply system
- HP Heat pump
- ÚČOV Central Wastewater Treatment Plant
- ZPS Paid parking zones

While a decade cannot be expected to bring about miracles, it can be the beginning of new positive trajectories for the life and management of Prague, which steer it towards sustainable and climate-responsible development, and aid in its departure from a dependency on fossil fuels and CO₂ emissions.

Martin Bursík, chairman of the Committee on Sustainable Energy and Climate

<https://klima.praha.eu>