

Transition Roadmap City of Vienna

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 893509

AUTHORS

Prepared by John O'Shea, Neil O'Leary (CODEMA)

- Bilbao: Jon Gonzalez Mancisidor, Patxi Hernandez
- Dublin: John O'Shea
- Munich: Tilmann Rave
- Rotterdam: Astrid Madsen, Marie-Emilie
 Ingen Housz
- Vienna: Michael Cerveny, Nick Sinner, Viktoria Forstinger, Andreas Veigl
- Winterthur: Rita Gnehm, Heinz Wiher, Urs Buchs

Reviewed by Viktoria Forstinger, Nick Sinner

Published: 07/2023

PROJECT INFORMATION Project name: Decarb City Pipes 2050 Grant agreement number: 893509 Project duration: 2020-2023

DISCLAIMER

The sole responsibility of this publication lies with the author. The European Union is not responsible for any use that may be made of the information contained therein.

This document contains materials that are copyrighted by the Decarb City Pipes 2050 consortium partners and may not be reproduced or copied without written permission. The commercial use of any information contained in this document may require a license from the owner of that information.

The authors do not guarantee that the information contained in this document is ready to be used as it is, or that use of such information is free from risk and will accept no liability for any loss or damage experienced by any person and/or entity using this information.



Transition Roadmap of Vienna

Introduction

The City of Vienna is committed to achieving climate neutrality by 2040. The City can build on extensive groundwork as it has pursued a comprehensive strategic climate policy since the late 1990s when the City Council adopted the Climate Protection Programmes (KliP in 1999 and KliP II in 2009).

Vienna's climate goals were laid down in the government agreement of 2020 and adopted in the updated **Smart City Wien Strategy** (2022) by the City Council. They comprise objectives both for climate protection and climate adaptation. In combination, they are to safeguard the quality of life for all Viennese and are to accomplish climate neutrality and climate resilience.

The Vienna Climate Guide describes the path towards Vienna's climate goals until 2040 with a view to a climate-friendly city outlines basic directions. and It corresponds to a compact implementation strategy that identifies the common levers climate protection (and for climate adaptation). The measures to be given priority and the tools behind them are, however, not specified in detail nor are they finalised

In concretization of the Climate Guide, the concept "Raus aus Gas - Wiener Wärme und Kälte 2040" ("Vienna Heating and



Cooling 2040") takes on the building sector and outlines the path towards a climateneutral city according to the motto "Raus aus Öl und Erdgas" ("Goodbye to Oil and Natural Gas") in the building sector.

Vienna's Transition Roadmap – the third central product / milestone in the context of the Decarb City Pipes 2050 project – comprises both, central parts of (verbatim where translation available) the **Vienna Climate Guide** (in German "Wiener Klimafahrplan", verbatim "Vienna Climate Roadmap") which deal with buildings and energy supply, and of the **Vienna's Heating and Cooling 2040 concept**.

The first chapter briefly elaborates the city of Vienna's climate strategy, while the second chapter gives a detailed outlook on Vienna's H/C sector in 2040. The third chapter outlines the main levers that are identified in the "buildings" and "energy" sectors to achieve this vision, and the fourth chapter details specific instruments to activate these levers.

The final chapter gives a brief outlook on the "Raus aus Gas" ("Goodbye to Gas") programme, kicked off only in late 2022, which is the, cross-department process tasked with implementing the switch away from fossil heating systems from now until 2040

Status Quo & Goals for 2040

Figure 45 outlines the greenhouse gas balance for Vienna²³ and shows how overall greenhouse gas emissions have developed in Vienna since 2005 and which sectors have generated them. It presents all the emissions released to the atmosphere in Vienna, e.g. by heating systems, vehicles, power and heating plants, other combustion systems or diffuse sources. This "production-based" or "territorial" inventory is commonly used in international and national climate policy and follows standardised calculation methods.



FIGURE 45: SECTORAL BREAKDOWN OF GREENHOUSE GAS EMISSIONS IN VIENNA 2005-2019 (SOURCE: VIENNA CLIMATE GUIDE)

Over the last 5 years, on average, almost 30 percent of the greenhouse gases relevant for Vienna's CO₂ headline goal were produced by **heating systems installed in buildings**.

In the "Energy" sector, more than 95 percent of emissions are produced by power plants with a capacity of more than 20 megawatts (e.g. power and district heating plants or cogeneration plants) that fall under the scope of the European emission trading system (shown as "Energy (ETS)" in Figure X). Smaller plants with a capacity of less than 20 megawatts account for a minor share (shown as "Energy (non-ETS)" in Figure X). In accordance with the distinction between sectors covered by the ETS and sectors remaining a national responsibility, the emissions of plants subject to European emission trading are not included in Vienna's climate protection headline goals. In order to address, nevertheless, the major emitters subject to the ETS, the Smart City Wien Strategy and the Vienna Climate Guide still set ambitious objectives. However, they only indirectly relate to greenhouse gas (GHG)

²³ By the Environment Agency Austria

emissions by laying down pathways for the expansion of renewable energies in order to decarbonise the production of electricity and district heat.



FIGURE 46: PATHWAY OF VIENNA'S GREENHOUSE GAS EMISSIONS TO THE 2040 TARGET (SOURCE: VIENNA CLIMATE GUIDE)

These greenhouse gas emissions relevant for the headline goal, as broken down by producers in Figure 46, are to be reduced to net zero by 2040 in line with the government programme of the Vienna City Government and the respective headline goal of the Smart City Wien Strategy.

Based thereon, the Smart City Wien Strategy defines targets for the development of greenhouse gas emissions in Vienna, energy consumption and Vienna's remaining "carbon budget" (see Figure 46):



Core Priorities

In order to fulfil its emissions targets the following core priorities - relevant for heating and cooling - can be derived from these goals:

Goodbye to gas in heat generation by reducing the heat consumption of buildings and by switching to district heating and the use of ambient heat by means of electricity-powered heat pumps. As a large share of these emissions stems from gas heating systems, Vienna's climate policy has to address them as a priority.

The decarbonisation of electricity and district heat production is to be made possible by the expansion of renewable energies in Vienna and Austria.

Green gas is to be available for co-generation plants and other energyefficient applications but not for heating buildings or supplying hot water in Vienna. Nuclear energy remains excluded as part of the solution.

Buildings

From 2014 to 2018, Vienna's building sector, specifically heating, cooling and hot water supply, accounted on average for almost 30 percent of the greenhouse gas emissions of relevance for the headline goal. Oil- and coal-fired heating systems hardly play a role here. Almost 90 percent of CO₂ emissions recorded in the building sector are generated by gas heating systems — mostly by around half a million gas boilers in homes or workplaces and, to a minor extent, by gas-fired central heating systems serving one or more buildings.

Apart from waste management, **the decarbonisation of the building sector may be the biggest challenge on the way towards climate neutrality in Vienna**. This is due to the following reasons:

- The legal framework for ensuring security of planning and investments, both for building and home owners and energy suppliers and system operators, is still lacking. Especially the provisions of housing law and the Natural Gas Sector Act applying to multi-family and multi-storey residential buildings as well as mixed use buildings prevailing in Vienna constitute major obstacles to decarbonisation. The basic conditions required for the transition in heating are just being prepared or under political discussion at both the federal and Viennese levels.
- There is not much time left until 2040: The refurbishment or replacement cycles of relevant building parts and heating systems are measured in decades. In the building and heating sector, in particular, changes are therefore much lengthier than in other sectors. If the phase-out is to be completed for oil by 2035 and for gas by 2040, numerous heating systems will have to be replaced before the end of their technical service life.
- Hundreds of thousands are affected: The necessary conversion measures require interventions in hundreds of thousands of apartments and tens of thousands of buildings that will be felt by many people and, for some of them, will result in changes to their habits. The expansion of the district heating system will temporarily be visible and audible in many streets.
- More well-qualified key workers are needed: Key sectors are partly affected by a lack of appropriately qualified workers. Both the massive increase in the thermal rehabilitation of buildings and the installation of many more climate-friendly heating systems require more specialised workers and, therefore, timely qualification programmes and re-trainings but, at the same

time, give an enormous boost to employment and value creation in the labour market and for the economy of Vienna.

Costs are incurred: It will not be possible in each case to finance the conversion measures from the reserves established for buildings. And it will not be possible in each case to compensate these one-off costs by lower expenditure on energy within a reasonable period of time. Thus, tailored solutions have to be found for this problem, too, in order to protect Vienna's residents against excessive financial burdens.

Climate protection goals for the building sector:

- We completely phase out fossil heat supply by 2040.
- The final energy consumed per capita by heating, cooling and hot water systems in buildings decreases by 20 percent by 2030 and by 30 percent by 2040
- Related per-capita CO2 emissions fall by 55 percent by 2030 and to zero by 2040
- Developers' competitions in subsidised housing accelerate social innovations and new solutions for climate protection and climate adaptation.

In the government agreement, the City Government also laid down that:

- "Fossil fuels are phased out for heating, cooling and hot water supply by 2040."
- "…green gas, including hydrogen from renewable energy sources … is to be used for co-generation plants or other high-grade energy purposes rather than for heating and hot water supply in Vienna."
- "Within the next two years, a concept will be developed for the gradual switch from fossil-fired heating systems to district heating and renewable heating systems in existing buildings by 2040..."

Energy Supply and Infrastructure

Decarbonisation and the massive expansion of electricity and district heating systems entail challenges, as renewable energy sources must be integrated to an unprecedented degree within a relatively short timeframe. In its turn, this calls for the expansion and restructuring of the respective grid and storage infrastructures. Achieving this ambitious goal while preserving the reliability and affordability of energy supply will make high demands on all parties involved. At the same time, it is clear that the renewable energy sources to be tapped in order to reach this goal must be CO₂-free and should originate largely in Vienna and the surrounding region. This makes us less dependent on geopolitical imponderables in the countries of origin of petroleum and gas or along transport routes. The regionalisation of energy supply will also enable us to face occasionally skyrocketing energy prices on the world markets with some serenity and allow us to expect more stable energy costs with long-term affordability.

As indicated above, emissions from plants with an installed capacity of less than 20 megawatt fall under the national scope of responsibility and those from larger plants with an

installed capacity in excess of 20 megawatt are covered by EU emission trading and therefore excluded from the headline goal. Thus, the Smart City Wien Strategy does not set any fixed targets for 2030 or 2040 to be complied with by Vienna's energy sector. However, targets for the expansion of the renewable energy generation sector within Vienna's municipal territory as well as for the share of renewables in the final energy consumption of the city were laid down and must be implemented essentially – but not exclusively – by the energy industry:

Goals for energy supply and infrastructure

- By 2030, renewable and decarbonised energy generation in Vienna equals three times and, by 2040, six times the volume of 2005.
- Vienna's final energy consumption will be covered by renewable and decarbonised sources at a rate of 50 percent in 2030 and entirely by 2040.

In addition, Vienna's government agreement of 2020 defines **short-term targets for expanding the photovoltaics sector** within the municipal territory:

Vienna increases its electricity generation within the municipal territory by means of photovoltaics (PV) at least to 250 MW_{peak} by 2025 and to 800 MW_{peak} by 2030. These targets will be reviewed in 2023 regarding their technical and economic viability and stepped up, if possible.

Vienna's H&C Outlook 2040

Vienna's Heating and Cooling vision for 2040 at a glance

100 % renewable energy for heating and cooling. The city's vision is to heat and, where necessary, cool all buildings in Vienna in a climate-neutral, emission-free and renewable way in 2040. Fossil fuels will no longer be needed for heating and cooling.

The central district heating network mainly supplies the densely built-up areas and will be re-densified especially where district heating is already available. District heating will thus supply a high proportion of existing buildings in areas of the city with a high heat demand density. In addition to the expansion, district heating will also be decarbonised, so that by 2040 fossil energy will no longer be needed to generate district heating. Local heating networks will be built for area and neighbourhood solutions in those areas of the city that are not suitable for the central district heating network despite high heat density. Renewable building heating systems are used in new buildings and also for existing buildings in areas with a rather low heat demand density. The renewable on-site potentials will be used in the best possible way and integrated into the respective energy system. There are isolated gas

supply areas for industry and power plants that produce electricity and heat and are fed with green gas.

This vision is based on the current heat demand density in the individual areas and the existing district heating routes. The district heating network has been developed in the past in such a way that areas with a high heat demand have been developed.

In addition to the heat demand density, other technical, economic and legal restrictions must also be taken into account in the future when expanding the grid.



FIGURE 47: HEATING AND COOLING – TODAY AND TOMORROW (SOURCE: CITY OF VIENNA, ENERGY PLANNING)

Based on different previous projects mapping spatial heat demand and through information exchange with the DSO in Vienna, the draft H/C Plan for 2040 was established (and previously submitted for Deliverable D3.3). It highlights the spatial distribution of energy solutions with the dense inner city dominated by district heating (existing respectively with planned extension) and outer districts and less densely populated areas more suitable for single solutions.



FIGURE 48: VIENNA'S HEATING AND COOLING PLAN (SOURCE: VIENNA HEATING AND COOLING PLAN)

Pathways and Levers

Buildings

The reduction of per-capita CO2 emissions by 55 percent by 2030 and to zero by 2040 requires that final energy consumption and the energy mix develop as shown in Figure 49. Due to the increasing number of refurbished buildings, final energy consumption falls in the building sector in absolute terms, in spite of expected further population growth that results in a rise of the heated area by more than 50 m² per additional resident (in housing plus non-residential buildings). The share of gas in final energy consumption declines from more than 40 percent today to less than 30 percent by 2030 and to zero by 2040. The remaining use of fuel oil is to be finally consigned to the files of history by 2035. Gas heating systems are primarily replaced by district heating, which will be substantially expanded, or heat pumps.

The pathways shown below do not envisage a linear development from now to 2040 but rather a "ramp-up" of heat/energy measures from approximately the mid-2020s on.



FIGURE 49: PATHWAY OF GREENHOUSE GAS EMISSIONS IN THE BUILDING SECTOR BY 2040 (SOURCE: VIENNA CLIMATE GUIDE)

The initially low replacement rate — see Figure 50 — is based on the assumption that a substantial upward trend and the required multiplication of both annual new connections to the district heating network and annual installations of new heat pumps can only be expected after the framework conditions relevant for Vienna will have been adapted at the federal and Viennese levels.



FIGURE 50: PATHWAY FOR ANNUAL SWITCHES FROM RESIDENTIAL GAS HEATING SYSTEMS TO CLIMATE-FRIENDLY SYSTEMS (SOURCE: VIENNA CLIMATE GUIDE)

It is all the more important to put in place and communicate swiftly the changes outlined below in order to ensure a high level of security of planning and investments for all. This is what building owners need for the replacement of their heating systems on the one hand and what system operators and energy suppliers require for the timely provision of network infrastructures and production capacities for additional district heating connections and heat pumps on the other hand. And, finally, clarification is needed on how all this can be accomplished while ensuring social sustainability.

Lever 1: Creating the framework for phasing out fossil heating systems

The key to decarbonising heating supply in Vienna is the phase-out of fossil heating systems. To this effect, several fundamental measures have to be implemented so that clarity prevails among citizens and businesses on the one hand and a strategic framework providing orientation is defined on the other hand.

- Creating a clear legal framework: Specific rules are needed for phasing out oil and gas heating systems on a legislative basis. Vienna's endeavours are currently supported by the negotiations on the Renewable Heat Act at the federal level. It is planned to regulate the phase-out of fossil heating systems at the federal level while also laying down reliable and adequate provisions cushioning the social impacts. On this basis, Vienna will adopt legislation adding important details and rules specifically necessary for densely built-up urban space.
- Creating data bases: The collection and compilation of a robust basis of data at the building and apartment level is essential for the gradual and spatially co-ordinated replacement of fossil heating systems as well as other fossil-fired system, for example in craft businesses. The legal basis for these efforts will be created at the provincial level.
- Supporting tools of integrated spatial and energy planning: Among others, one essential regulation that still needs to be introduced in the Building Code for Vienna is the extension of integrated spatial and energy planning from new buildings to existing buildings and heating systems. At the transition to the citywide phase-out of fossil heating systems, integrated

spatial and energy planning is an opportunity for advancing the switch – differentiated in space and time – to district heating or renewable energy systems and supporting a co-ordinated modification of energy infrastructures that satisfies spatial demands and comes at the best cost possible. What is envisaged at present is a zone model that prioritises different heat supply options depending on infrastructure availability and shows the time of availability in a phased approach within the framework of the integrated spatial and energy plans for existing buildings. The related ideas are specified in concrete and partly also in spatial terms in the "Heating and Cooling Vienna 2040" strategy (see below).

Decarbonising district heating: In a large part of the densely built-up urban area, a switch from gas heating systems to district heating is the most important measure for decarbonising the building sector. From an overall perspective (also taking account of the emissions of the energy and ETS sectors), however, this strategy only makes sense if district heat is produced without fossil fuels. The way in which this can be accomplished and which measures will be taken by Vienna (also including the additional framework conditions required) is explained in Chapter 4.6 "Electricity and district heat generation".

Lever 2: Reducing energy consumption and using renewable heating systems

In order to accomplish the desired reduction of final energy consumption, the number of flats that are thermally rehabilitated per year has to be increased to 25,000 in the next few years and then kept at this level until 2040. A similar development is needed for non-residential buildings. On average, each rehabilitation project should, if possible, halve the energy used for heating and optimise the energy used for hot water supply, as the latter will increase on average as a result of the frequent centralisation of hot water systems. In addition to thermal rehabilitation measures, heating systems, too, are to switch to district heating or renewable energies in the course of energy-related refurbishment, which frequently requires the centralisation of hot water supply.

Tailored programmes are needed that offer and support appropriate solutions for buildings. Both the type of climate-neutral energy supply and meaningful thermal rehabilitation measures depend, first, on the location of a building in one of the zones identified in the integrated spatial and energy plans and, second, on the type of building (e.g. historical office building or residential building from the 1960s).

Therefore, we are working on the following measures and programmes:

Programmes promoting thermal rehabilitation and boiler exchange: Building on decades of experience and on the reflections on the integrated spatial and energy plans for existing buildings, appropriate, targeted promotion programmes are to be developed and framework conditions are to be adapted. The aim of promotion always has to be both the provision of incentives and the equally vital cushioning of social effects of a switch to renewables or district heating — as far as possible in combination with meaningful thermal rehabilitation measures. Within the framework of the heating strategy, the Federal Government signals additional funding lines that also are to address multi-storey buildings and will provide financial support to people obligated by regulatory requirements to make investments. Here, it is important to ensure that promotion programmes are co-ordinated between the Federal Government and the federal provinces and that adequate funding is provided for Vienna's plans (e.g. centralisation of heating systems and replacement of gas boilers). The budget volumes have to be sufficiently high for achieving the objectives and secured in the longterm and should be co-financed by the federal level. In particular, the financial support provided has to ensure the very generous cushioning of social effects for people who cannot afford the conversion of their heating system.

- Training programmes and labour market initiatives: The investment volume unleashed by the planned thermal rehabilitation and energy-related refurbishment drive amounts to significantly more than one billion euro per year. At the same time, such a programme strengthens numerous economic sectors and creates or secures in excess of 15,000 jobs. These effects stimulating the labour market are to be supported by appropriate training programmes and labour market initiatives.
- Pilot programmes, such as "100 buildings: Bye, bye gas boiler, hello renewables": Work is to be performed on various programmes and demonstration projects. In this context, however, numerous technical, organisational, legal and financial aspects of the business models still have to be clarified. The pilot and demonstration programme "100 buildings: Bye, bye gas boiler, hello renewables" is to develop solutions for the particular challenge of switching from gas boilers to renewable energies. In addition, we need a promotion and networking programme that supports pilot projects implemented at the interface between research, demonstration and dissemination and is backed and funded by the City of Vienna (ideally with co-funding from the Federal Government and/or the EU). This programme is to be set up soon. What is especially important here is the full transparency of planning, the evidence obtained and the implementation of such pilot projects, as this is a requirement for a broad rollout, including the provision of training to energy consultants and authorities.
- Accompanying programmes, such as consulting, dissemination of information, awareness raising: In Vienna, for example, the "Hauskunft" counselling service is to be upgraded into a one-stop shop for all issues related to the refurbishment of buildings and the switch to new heating systems. Vienna will also prepare a timely, comprehensive information campaign with a broad impact in order to make the building owners concerned as well as citizens and the enterprises needed for implementation aware of the new legal requirements and the related financial or other support offered by the City of Vienna.
- Voluntary agreements so-called "climate alliances" between the City of Vienna and large building owners and managers or enterprises are to

create a platform for mutual assistance on the way to an oil-and gas-free building stock.

The City of Vienna and its undertakings as a role model: The aim is to heat buildings occupied by municipal authorities exclusively by means of climate-friendly energies by 2035 and to equip them with photovoltaic systems wherever technically feasible in the next few years. By 2025, municipal undertakings are to draw up a plan on how their building stock can be decarbonised by 2040 and which buildings are to switch from fossil fuels to district or renewable heating by 2030.

Energy Supply and Infrastructure

It depends on many factors which solution can be sensibly implemented and where. In the future, renewable energy solutions will be combined in the best possible way so that appropriate solutions are available for all framework conditions. To avoid being limited to lighthouse projects, easily replicable solutions must be implemented and the heating system switch rate successively increased. A variety of renewable sources and waste heat are available for this purpose.

Renewable electricity in the heat transition

In the future, Vienna will be supplied with heating and cooling mainly by decarbonised district heating and heat pumps. Both technologies require electrical power for their operation. Due to the large number of buildings that will be converted from gas supply to a heat pump solution, it is currently expected that the annual electricity consumption for space heating and hot water will increase from currently 1.8 TWh to 2.7 TWh, which corresponds to an increase of 50%. Decarbonised district heating will also have an increased electricity demand, as heat pumps, large-scale heat pumps and deep geothermal energy will account for a large share of district heating in the future. Here, an increase from 0.50 TWh to up to 0.85 TWh is expected. This corresponds to approx. 10% of Vienna's total electricity demand.

For a climate-neutral Vienna, this electricity must of course come from renewable sources. Due to the urban structure, which only allows wind energy use to a very limited extent, and the planned phase-out of fossil energy in electricity production, Vienna's electricity production will decrease by 2040 despite the existing solar power offensive. Photovoltaics will play an essential role for Vienna, as this technology can be well integrated especially in buildings. With the Vienna Solar Power Offensive, which was launched in 2021, work is already underway to increase the installed PV capacity from currently around 100 MWp to 800 MWp by 2030. The focus is on the use of areas that are already sealed.

Wind energy will play an important role in Austria's electricity production, but only a limited one in Vienna. Due to the dense development, Vienna offers hardly any suitable locations for wind power plants. The expansion of hydropower is also only possible to a very limited extent within Vienna.

Accordingly, Vienna will cooperate with the surrounding area. As a large city with high energy consumption, Vienna is required to use the renewable electricity surpluses from the surrounding area and act as an energy storage facility. In order to be able to safely distribute

the increasing amounts of electricity in Vienna's power grid in the future, continuous grid expansion is necessary.

Renewable ambient heat

Locally available heat is an essential component for future energy supply. In urban areas, geothermal heat, heat from groundwater and heat from the air can be extracted by means of heat pumps and used for individual or several buildings. In addition, solar thermal energy offers a valuable supplement. Heat that is available at great depths can be fed directly into the central district heating system by using deep geothermal energy. In this way, renewable sources on the outskirts of the city can be used to supply dense urban districts.

Waste heat as a renewable energy source

In order to replace fossil fuels and switch to district heating on a large scale, the direct use of waste heat is an important component. Waste heat from high-temperature applications, e.g. from waste incineration plants or combined heat and power (CHP) plants, can be fed directly into the district heating network due to the high temperature level. Low-temperature waste heat sources, such as waste heat from sewers or waste water heat, can still be used for space heating and hot water preparation by means of heat pumps. Other sources of waste heat are office buildings, supermarkets, commercial enterprises and data centres or server rooms. Waste heat sources must be used locally in the best possible way by coordinating energy requirements with locally available sources as early as possible and taking them into account in planning processes at an early stage (for example in district solutions for heat production for flats). Seasonal storage of waste heat, e.g. in geothermal probe fields, can make surplus heat in summer usable as a heat source in winter.

In the future, the electricity demand for cooling in Vienna will also increase significantly (according to the Compass Lexecon study by 240 % from approx. 300 GWh in 2019 to more than 1 TWh in 2040). An increased use of individual cooling and air-conditioning devices in this context would also mean an increased release of waste heat into the urban space, which would further heat up the city in the summer months. This development must be countered with alternative solutions such as district cooling networks (especially for service buildings) or seasonal building cooling using geothermal probes. Currently, many waste heat flows are still discharged unused into the environment. Appropriate regulations will be needed to ensure that waste heat is used in the best possible way.

Biomass - limited use in the city

In Vienna, the use of biomass (e.g. wood pellets, wood chips or logs) in heating systems of single and multi-family houses as well as in multi-storey residential buildings is currently at a very low level. In addition, biomass contributes a small part to district heating production. An increased use of biomass for heat supply in the Viennese building sector is also not planned for the future. Biomass only grows to a limited extent each year and is therefore not sustainably available in unlimited quantities. In addition, climate change has a negative impact on domestic wood species in some cases. Not least for logistical reasons, bioenergy should rather be used close to its origin, i.e. in rural areas. Moreover, biomass is a high-quality energy source with a high energy content, which should therefore not be used primarily in the low-temperature range, but for higher-value uses.

If there are reasons for excluding the use of heat pumps or connection to district heating, the use of biomass in individual heating is in any case a suitable alternative. Biomass is especially suitable where a lot of energy is needed in a small area, as it is a relatively dense energy store and can also generate high-temperature heat. In multi-storey residential buildings outside the district heating area, the energetic use of biomass could be used in isolated cases as a central heat supply. One advantage here would be the efficient central flue gas cleaning compared to many individual heating systems.

Green gas for industry and power plants

It can currently be assumed that even in 2040 and beyond, the availability of green gas in Europe will be quantitatively limited and correspondingly expensive. The reasons for this are the high demand for different areas of application (e.g. chemicals, steel, aviation and shipping) and the production and supply structures that are still being developed. Against this background, the already scarce quantities of green gas in Vienna will not be used in the low or medium temperature range and thus not in individual buildings to supply them with heating and hot water. Vienna will continue to rely on gas-fired plants to maintain and cover peak loads in the electricity and district heating supply. The use of green gas is advantageous here due to its high energy density and seasonal storage capability. The use of green gas is therefore only envisaged for Vienna where there are no other alternatives, such as in CHP plants, in high-temperature applications in production and temporarily in parts of public transport.

It is of great importance for Vienna that green gas is available in sufficient quantities and at acceptable prices for the above-mentioned areas of application. Incentives must be created to make the best possible use of the potentials in Vienna and to enable the development of green gas production and use.

Joint implementations

In the coming years, measures for the decarbonisation of the building stock, measures for climate change adaptation and measures in the field of mobility will require space in the public space. In order to be able to take as many aspects as possible into account in individual projects and to proceed in a coordinated and holistic manner, a suitable coordination office must be established. This ensures that all of the aforementioned topics are considered in the course of a project. This can reduce investment costs, construction site times and the impact of construction noise.

Switching from fossil fuels to renewables for energy supply on the one hand entails the reduction of fossil, emission-intensive energy sources and greater energy efficiency. On the other hand, it increases the demand for environmentally friendly forms of energy. The chart below gives an overview of how electricity and district heat generation, which currently is still largely based on fossil fuels, is to be transformed into a climate-neutral system by 2040.

Lever 1: Tapping renewable electricity potentials on site

In the field of renewable electricity generation in urban areas, special importance must be assigned to photovoltaics (PV). Vienna plans to step up electricity production by means of PV within the city from currently 50 MWpeak (2020) to 250 MWpeak by 2025 and to 800 MWpeak by 2030. In this, Vienna will apply the following levers:

- Mobilisation of surfaces on built structures and plots owned by the City of Vienna or associated facilities: Evaluation of suitability by 2022, implementation of PV plants on buildings and land owned by the City of Vienna by 2025; target: 50 MWpeak on buildings owned by the Vienna City Administration.
- Utilisation of all technical space potentials and fostering of the installation of innovative PV solutions well adapted to urban conditions: In addition to roof and façade surfaces, this concerns above all plants in public and semi-public space, such as parking lots, noise barriers, motorways, underground and aboveground rail lines, shading installations for halls and outdoor areas.
- Simplification of approval procedures and adaptation of legal framework conditions in the Vienna Electricity Management Act and in provisions under construction law.
- Special subsidy programme for community PV plants: In highly condensed urban agglomerations such as Vienna, the roofs of apartment buildings are of enormous importance for increasing the PV volume. The installation and maintenance of such plants is substantially more costly than that of PV plants mounted on other surfaces. Therefore, a subsidy bonus could prove a key investment incentive to step up such installations.
- Increase of subsidies and creation of new subsidy programmes, e.g. innovation funding for multi-purpose plants including PV plants on parking lot roofings or carports, building-integrated or floating PV plants; subsidies for lightweight and foil modules to tap large-surface potentials on halls; combined subsidies for PV-cum-storage devices.
- Mobilisation of owners of large-scale roof surfaces suited for PV installation (housing developers, industry and trade): Assistance provided through customised information and support packages; Solar Prize of the City of Vienna.
- Wider obligation to install PV plants on all newly built structures as well as for all larger structural modifications of roofs.
- Support of further network expansion in integrating additionally created PV capacities.
- Broad awareness raising and solar energy campaigns: "My City, My Power Plant"; Vienna invites all citizens to become part of the Vienna PV offensive; counselling for renewable energy communities; development of a centre for renewable energy resources to provide advice and information about subsidies and necessary approvals related to renewable energy resources.

Lever 2: Ensuring renewable district heating

As owners and operators of central infrastructure facilities, the City of Vienna and the Vienna public utilities (municipal enterprises) find themselves in the favourable position of being able to shape the transformation of energy generation to a significant extent. At the same time, it is evident that entrepreneurial decisions need conducive framework conditions in this area as well – especially since this will involve investments totalling several billions of euro

until 2040. And these framework conditions must be delivered by both the City of Vienna and the Republic of Austria!

The possibilities open to Vienna include the following:

- Unlimited support by the City of Vienna, also in its capacity of owner, for decisions to be taken by the managements of the Vienna Public Utilities (Wien Energie, Wiener Netze) regarding
- o Tapping and integration of large-scale deep geothermal energy potentials,
- Integration of ambient and waste heat potentials by means of large-scale heat pumps,
- Expansion of the district heating network, specifically in inner-city areas, but also in zones with high thermal density independent of the centralised integrated grid (local neighbourhood heat networks, anergy networks),
- Implementation of heat storage units.
 - Quick and optimised support of projects designed to enhance the share of renewables, to be extended by the City of Vienna in the course of administrative procedures (under water law, construction law, law on industrial and commercial plant operation, land use law).
 - Incentives and/or regulatory frameworks for the rapid connection of existing buildings and all dwellings inside them to district heating as soon as the district heating grid is available in the area in order to safeguard that investments in the district heating grid can be quickly refinanced.
 - Integrated Spatial and Energy Planning 2.0: Extension of this approach combining climate protection and spatial planning (see Article 2b of the Building Code for Vienna) to the existing building stock; development of planning materials for optimising the selection of suitable energy sources and technologies for fossil-free heating by 2040 in co-ordination with existing settlement structures and infrastructures as well as heating providers.

Lever 3: Using green gas to cover peak loads

- Conscious utilisation of green gas:
- In the future, green gas is to be used in Vienna for co-generation plants or other applications of high energetic benefit, but not for space and water heating.
- Continued operation of power plants and co-generation plants fuelled by green gas to cover peak loads and for stabilising the power grid in and around Vienna.

Instruments to be used

"How do we go about it?" is probably the most essential question before major transformations. The complexity of decarbonising the city of Vienna, with its countless buildings and diverse framework conditions, requires thoughtful planning. This way, the right

measures can be taken at the right time. To this end, this chapter provides tools to achieve and influence the 2040 target. These instruments are constantly being further developed so that they support the implementation of the building blocks in the best possible way.

Instrument 1: Spatial energy planning

With the ordinance of spatial energy plans according to § 2b of the Building Code for Vienna, a basis for spatial energy planning has already been created, which supports the expansion of district heating and the use of renewable energies in new buildings.

The next step will be to extend spatial energy planning to existing buildings and heating systems. In doing so, it will be increasingly important to address the starting situation of the existing building stock and, against this background, to shed light on the different possibilities for switching energy sources. Depending on locally available energy sources (district heating available yes/no, renewable potentials), structural building parameters (partial thermal renovation/refurbishment required or already carried out, furnishings of the dwelling, possibly listed buildings/protection zones) and other relevant aspects, appropriate framework conditions must be developed, e.g. on the planning, legal and subsidy policy side.

The parameters mentioned above result in different solution options within the urban area, the development of which can be supported and driven forward in a coordinated manner by energy space planning. Roughly speaking, three options can be distinguished:

- 1. The first solution option comprises the **further development of the grid-based infrastructure - especially district heating**. The expansion and densification of district heating form the backbone of tomorrow's climate-friendly building supply.
- Another solution option are the renewable energy sources available within the city for building-specific energy supply. Wherever heat cannot be supplied by means of heat grids, individual buildings are supplied with energy resources available on site.
- 3. The third solution option is a **mixture of the first two and combines inner-city energy potentials at building level with a grid-based energy supply**. So-called local heating networks are to be created that supply a neighbourhood or a block of houses with locally available energy.

Instrument 2: Legal framework

In 2020, the federal government and the provinces agreed on a joint framework for decarbonising the heat supply as part of the so-called heating strategy. In numerous working group meetings on various topics, the framework conditions for the transition to a climate-friendly heat supply were discussed. The results led to the draft of the Renewable Heat Act (EWG) as the central legal basis for the topic. This is a federal law that contains precise specifications on when and how the phase-out of fossil fuels in space heating must take place. Subsequently, the federal provinces have to enact the accompanying regulations in the respective material laws and according to the respective enforcement regime, which are necessary in order to be able to effectively implement the requirements of the EWG. In this context, it is particularly challenging that the EWG was not yet in force in 2022 and is still not in force even in January 2023. Only when the EWG has been passed and announced in the National Council can the supplementary provincial laws be enacted. This creates

uncertainties and a certain time pressure, as regulatory measures must be taken in time to be able to achieve the 2040 target. Especially since the exact content of the EWG has not yet been determined, various contingencies must be considered in the best possible way and transitional as well as "emergency solutions" must be worked out.

In connection with the enactment of the necessary provincial regulations, it will first have to be decided in which regulatory regime this should find a place. The current building regulations of the Building Code for Vienna and the Building Technology Regulation already contain far-reaching specifications that guarantee the extensive use of renewable energy sources, also in the area of heat supply, at least for new buildings, additions and conversions or major renovations of a building. As part of the preparatory work for the amendment to the building code planned for 2023, it is currently being examined to what extent these regulations can be tightened in order to contribute to the decarbonisation of the building stock.

Regulations on decarbonisation could find a place in the regime of heating and airconditioning law or also in a new provincial law yet to be created. For the enforcement of the regulations yet to be enacted, it is indispensable to collect the data that provide precise information on which spaces in Vienna are equipped with fossil fuel heating systems. Thus, in a first step, legal foundations will be created that allow the collection and processing of the data in order to subsequently make it available to the authorities in a database.

It will also be necessary to adapt other substantive federal laws, such as the Gas Industry Act or the various housing laws such as the Condominium Act, the Tenancy Act or the Non-Profit Housing Act. On the one hand, the implementation of energy system conversions must be simplified, and on the other hand, the bearing of costs must be regulated in a fair and socially acceptable manner. The federal government is responsible for legislation in this area. It is therefore important to bring the problems and the need for legal changes in connection with the decarbonisation of the building sector to the attention of the federal government at an early stage and in a consistent manner.

Instrument 3: Affordable housing, subsidies and financing

In order to achieve the decarbonisation of the city of Vienna and our goal of a climate model city, financial investments are indispensable. As a first step, planning and investment security must be created for all affected groups through jointly agreed goals and paths, in order to be able to prepare and plan building projects, coordinations and more as early as possible. Legal adjustments and statements that can be relied on are needed. At the same time, incentives and assistance must also be created that, on the one hand, influence investment and decision-making behaviour in such a way that they are compatible with our climate goals. On the other hand, these aids must cushion and prevent social inequalities and relieve the burden on citizens.

Costs of the heat transition (on the building side)

Approximately 608,000 housing units of use are affected, distributed over about 74,000 buildings. 608,000 utilisation units mean about 34,000 conversions or refurbishments per year. This results in an annual investment volume of almost 1.6 billion € in the next few years. For comparison or classification: 2 billion euros are about 2 % of Vienna's gross

regional product. And as already mentioned, only a part of this 2 billion represents "additional costs" compared to today's business-as-usual, because large amounts are already being invested annually in building renovation and building services. In order for these investments to be implemented in a socially just manner, subsidies are needed, which must be considered in time and communicated to the building owners and residents.

Subsidies for the heat transition

For a socially just implementation, this transformation must be affordable for all Viennese. Accordingly, the subsidies must be further expanded and their accuracy optimised as best as possible. Low-income households not only need financial support, but also information, counselling and guidance throughout the entire process of switching energy carriers. It will also be important to clearly define the roles of tenants and landlords or building owners. The problem of the user-investor dilemma must be taken into account and appropriate solutions found.

What needs to be taken into account in the further development of subsidies?
Long-term budget planning coordinated with the implementation plan and a related successive increase in the subsidy budgets for thermal renovations and heating conversions.
Creating possibilities for pre-financing infrastructure expansion in order to reduce the costs for "first-time converters" and to ensure the economic viability of the expansion.
Additional funding or support for cross-property initiatives (gas-free building blocks or streets) that want to "get out of gas" together.
There is a need for targeted subsidies with a high degree of social accuracy.
Better coordination of federal and provincial subsidies
Further development of funding to include measures relating to the

deconstruction of cooking gas.

Instrument 4: Communication, counselling and guidance

The heating transition can only succeed with the broad support of the public, citizens and building and flat owners. It will be the task of the City of Vienna to support and inform the different affected stakeholders with proactive information and communication measures. The combination of information, independent advisory services, subsidies and a pinch of creativity should significantly support the switch to renewable heating and cooling by 2040. This creates planning security - on the one hand for owners, on the other hand also for energy service providers, and the planning principles of energy space planning can be implemented in a coordinated manner across the city.

Consulting for the heat transition

In order to support the process in the best possible way and to make the switch to a renewable heating system as easy as possible, the City of Vienna already offers some assistance and must continuously work on expanding the offers.

Since autumn 2020, citizens who want to make their building or flat fit for the future can contact the "Hauskunft" (a combination of "Haus" (home) and "Auskunft" (advice or information)) for questions on topics such as renovations and heating system switches. It is the central advice centre of the City of Vienna. The services offered by Hauskunft will be continuously expanded and adapted to the needs of city residents in order to provide the best possible support on the way to climate-neutral heating and cooling. This is the only way to jointly achieve the goal by 2040.

The Renewable Energy Competence Centre ("Kompetenzzentrum Erneuerbare Energie") is the competence centre for all topics related to renewable forms of energy. Here, citizens can also receive counselling. The Renewable Energy Competence Centre will also set up an advice centre for energy communities. Renewable energy communities offer a good opportunity for citizens to jointly generate and consume electricity and heat. For example, a particularly cheap roof area of a multi-apartment building can be used jointly to generate PV electricity, and the electricity is then shared among the residents. These counselling services are complemented by the established format of "Gebietsbetreuung Stadterneuerung", which offers guidance and support on site in the neighbourhoods.

Instrument 5: Labour market and skilled workers

In addition to energy and climate policy goals, Heating and Cooling 2040 will also have a strong stimulus for the Viennese labour market, as in the near future there will be a need for sufficient craftsmen, plumbers, planners, skilled workers, etc. with appropriate quality training for the renovation of buildings and retrofitting of heating systems. This raises the important question of how a rapid energy transition can be achieved from the perspective of the labour market. On the one hand, the ecological transformation offers great opportunities to create additional jobs in Vienna. On the other hand, a lack of skilled workers and resource bottlenecks in the affected sectors jeopardise the implementation of the planned goals.

Within the framework of its environmental and climate policy measures, Vienna always aims to combine these with social policy measures. In particular, long-term strategies, such as the concept Raus aus Gas - Wiener Wärme und Kälte 2040 (Phasing Out Gas – Heating and Cooling Vienna 2040), offer the possibility that people who are currently outside the Viennese labour market can be reintegrated through specific training and further education. In order to obtain reliable data and facts on this very important instrument, a study was commissioned within the framework of the implementation programme in cooperation with the City of Vienna - Economy, Labour and Statistics (MA 23) and the Vienna Employee Promotion Fund (waff).

Within the scope of the study, an analysis of the status quo on the one hand and a needs analysis for the challenges and opportunities for the Viennese labour market on the other hand are to be prepared. The study is to be the basis for the development of economic, social and labour market policy measures and serve as a basis for further transformation processes. The waff's Skilled Workers Centre will play a central role in this.

waff skilled labour centre - focus on "decarbonisation and securing skilled labour"

The programme of the Viennese provincial government stipulates that a strategic labour market instrument - a skilled labour centre for Vienna - is to be established at waff. The most important tasks of the Skilled Workers Centre will include quantitative and qualitative analyses with regard to the demand for skilled workers in Vienna, the development of strategic options for action to solve the problem and the development of effective measures. The Centre for Skilled Workers is therefore not a training centre for skilled workers, but rather a competence centre where problem-solving strategies are developed together with various decision-makers. The aforementioned study should provide an important empirical basis for this. The official establishment of the Centre for Skilled Workers will take place in 2023 with the presentation of the first Skilled Workers Report for Vienna.

A decisive challenge is the identification of potentials for attracting additional workers and especially skilled workers.

The following areas are particularly important for this:

- Young people with regard to their educational and occupational choices.
- The potential of people with a compulsory school certificate or lower, who can be recruited for catching up on educational qualifications and for substantially higher qualification.
- An important group are also the employees of those companies that take on concrete assignments within the framework of the ecological transformation.
- People who currently work in "fossil" industries and whose field of activity will decline have a possible occupational field in professions that deal with renewable energy.
- Foreigners (EU citizens or third-country nationals) who are to be recruited for work activities in the context of the ecological transformation.

Especially with regard to the training of qualified workers, the typically long duration of training must be taken into account. The provision of further training infrastructure also requires lead time. As a result, the necessary training policy interventions must be made at an early stage to secure the supply of skilled labour in the future.

However, Vienna cannot solve the challenges of the labour market alone, as a large part of the responsibility also lies at the federal level. The definition of curricula for vocational schools, the number of places in vocational secondary education - to name just a few points - must be addressed for the whole of Austria. It will be essential to adapt training as quickly as possible to the new needs of the labour market and the challenges of the future. Dealing with renewable energy systems, thermal renovations or the installation of photovoltaic systems can no longer be seen as "add-ons", but must be included in basic training. Tomorrow's skilled workers must also learn to know and apply tomorrow's technologies in the best possible way if the climate goals are to be achieved.

The Road Ahead

The Vienna Heating and Cooling 2040 concept describes the major fields of action that are necessary for Vienna to become a CO₂-neutral climate model city. Of course, a concept alone is not enough to transform a city of millions from a fossil-fuelled to a renewable city. For this reason, the implementation of Vienna Heating and Cooling 2040 was already initiated in 2022 with the programme **"Raus aus Gas"** (RaG, "Phasing Out Gas") in the City Planning Department.

It is planned to divide this programme into two sections called RaG 1 and RaG 2. By 2025, the foundations identified as such by the concept are to be created so that a broad conversion of Vienna's building stock can be started from 2026.

The RaG 1 programme is strategically managed and coordinated by the Municipal Directorate for Buildings and Technology (Stadtbaudirektion). Numerous municipal departments, companies and enterprises of the City of Vienna are involved in the programme. This broad team is necessary so that the complex challenge of decarbonising the city's energy supply can be dealt with in a holistic manner.

Vienna's energy supply is largely dependent on fossil fuels. Three quarters of the gross domestic consumption come from fossil sources. More than one third of the final energy consumption can be attributed to space heating requirements and thus to buildings. If one takes into account that buildings also require process heat and electricity for electrical building equipment, it becomes clear how important the building sector is for achieving the climate and energy goals. This is where the heat transition comes in. In the future, space heating, hot water, cooling energy and energy for cooking (gas cookers) are to be provided from recyclable and environmentally friendly forms of energy.

In Vienna alone, about 600,000 households currently supplied with fossil fuels will have to be converted in the next 18 years. The majority of these households will be supplied with gas at the household level. A small part is equipped with central gas heating systems and a few tens of thousands of households still use oil heating. If this task is calculated down to daily conversions, it amounts to 100 households every weekday for the next 18 years.

In order to tackle this challenge, intensive work is currently being done to create the necessary foundations for the heat transition. In particular, the legal and subsidy framework must be adapted. In addition, the existing shortage of skilled workers must be counteracted in order to be able to cope with the structural changes. In order to coordinate the tasks of the public sector in connection with the heat transition, the implementation programme Raus aus Gas (Out of Gas) was installed in the Municipal Directorate for Buildings and Technology (Stadtbaudirektion).

For example, the programme is used to specifically **identify the financing requirements** for the heat transition in buildings (especially residential buildings, but also non-residential buildings), but also in the municipal offices.

Strategic public relations and communication will be developed, which on the one hand communicates the plans of the City of Vienna (to achieve the climate goals) and on the other hand supports the acceptance of the measures among the population.

A study will shed light on the areas in which the **labour market needs to be strengthened** in order to be able to draw on sufficient skilled labour.

Further phases are concerned with **optimising the funding landscape** in terms of achieving the goals and adapting the relevant provincial laws.

With the help of **energy planning in existing buildings**, it will be shown in which regions of the city district heating can be expected and where preference will be given to the use of renewable resources available on site.

Within the framework of the programme, **pilot implementations** are to be initiated at Wien Energie, Wiener Wohnen, municipal properties as well as non-profit and private developers and building owners. With the help of these pilot projects, existing technical solution options are to be tested and evaluated in order to finally roll out the most suitable measures to the entire city.

In particular, the initiatives "100 innovative projects phasing out gas" will **explore the needs of buildings of different ages and with different building equipment**. The technical solutions to refurbish buildings in a highly efficient manner and to convert them to sustainable forms of energy exist. The task now is to find out which options are most compatible with economic efficiency and benefits.

With the help of an **effective monitoring system**, the success of the heat transition is to be documented.

The programme interacts intensively with other climate-relevant projects of the City of Vienna, such as the circular economy or urban renewal offensives like Wien Neu+ and WirSanWien.

With the help of the critical success factors of the Raus aus Gas 1 programme, the largescale rollout in the context of Raus aus Gas 2 (from 2026) will finally be prepared. The rollout will then build on the established foundations of the heat transition and make use of the key findings from the first programme.





DECARB



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 893509

