Energy! ahead

Energy Report of the City of Vienna

Data for 2014/ Year of reporting 2016, Municipal Department 20

Stadt Wien

SMART CITY WIEN

ABBREVIATIONS

BLI	Bundesländer Luftschadstoff Inventur – survey of air pollutants in Austria
CHP	Combined heat and power
emikat.at	Emissions and energy data management system of the Austrian Institute of Technology (AIT)
GHG	Greenhouse gases
GIEC	Gross inland energy consumption
KliP	Climate protection programme of the City of Vienna
kWp	Kilowatt peak
MA	Municipal Department
MIT	Motorised individual traffic
PV	Photovoltaics
SCWR	Smart City Wien Framework Strategy
SEP	Urban Energy Efficiency Programme of the City of Vienna

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Energy! ahead

DATA 2014
for the City of Vienna

Wien! voraus
Energieplanung
StaDt Wien

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Maria Vassilakou
Deputy Mayor of Vienna, Executive City Councillor for Urban Planning, Traffic & Transport, Climate Protection, Energy and Public Participation

1 PREFACE

The Paris Agreement concluded at the 21st World Climate Conference (COP21) is a historic turning point and marks a worldwide commitment to ending the use of fossil energy sources. In light of global climate change, we need far-reaching and effective measures for an energy transition and we must do everything in our power to support sustainable technologies, innovative development and research. The government of the City of Vienna has recognised this and set a course for a forward-looking energy framework strategy. The energy framework strategy is being developed in close coordination with the existing climate goals and the principles of the Smart City Wien Framework Strategy. We aim to reduce CO_2 emissions by 80% by 2050. Energy supply security, renewable energy and energy efficiency are at the core of our efforts.

Cities offer great opportunities to steer the global energy system towards sustainability. More than half the global population is living in cities and some 80% of energy consumed worldwide is used in urban areas. By 2050, two thirds of the world's population are expected to live in cities. Growing urbanisation and the economic growth this creates increase urban energy consumption. Therefore, we, as decision-makers in the cities, hold the key to a successful energy transition and to reaching the climate goals.

Urban areas encompass more than just the city; they also include the greater region. In keeping with the goals of the Paris Agreement, the adjoining provinces of Burgenland, Lower Austria and Vienna are currently developing a joint strategic approach for a sustainable energy system. The exploratory project "EnergyLab East" aims to uncover potentials for an energy transition in eastern Austria. The project region is characterised by rural areas, where renewable energy generation can be expanded. At the same time, the growing urban centres in the region act as "energy sponges" that use renewable energy when it is available in excess and also store energy for times of lower production. The focus is on finding answers to anticipated challenges for local, regional and cross-regional grids as well as short-term and seasonal energy storage. We also aim to identify potential showcase projects. What is special about the project is that it is a cooperation between the three federal provinces (their provincial energy agencies and representatives of the offices of the provincial governments) and the three main energy supply companies in the region.

It is initiatives like this that benefit from the impetus provided by the Paris Agreement and help us implement sustainable energy systems. Together, we can reach our climate and energy targets and ensure clean, sustainable energy.

Maria Vassilakou

WOLFGANG MÜLLER
has been Deputy Chief Executive Director of the City of Vienna since 2010. He studied law while serving as an officer of the Austrian Armed Forces and has been working for the City of Vienna since 1991.

2 INTERVIEWS BY BERND VOGL

Wolfgang Müller, Deputy Chief Executive Director of the City of Vienna

BERND VOGL: *The City of Vienna has become more open about sharing its valuable data, which is a very positive development. I am sure that has to do with the efforts to activate the city's often-cited 1.8 million brains. We as the energy department aim to participate in this process and also make energy data available. You are in charge of a considerable part of this process and you are also one of the leading figures in the city's innovation strategy. What does it mean to make the city administration's data publicly accessible? What is the overall policy of the City of Vienna with regard to open government and open data?*

WOLFGANG MÜLLER: The key question when it comes to open government and open data is really a fundamental one: Do we believe in open access or not? We at Vienna City Administration began developing our open government strategy in 2011 and it has radically changed the way in which we work. Today, we regularly exchange information with various players and are always thinking about what else we could do and what other data we could share. When we started out, we were much more focused on obstacles, on why we could not do this or that. That is different today. Open government has changed us.

The process of making the City Administration more accessible is built on three main principles: transparency, participation and cooperation. That last one is most important – interacting with the community. And it's working. So far, we have published over 300 datasets, which have been used to develop 196 apps and visualisations. This allows us to reach an incredibly broad range of people.

What does publishing such data mean for privacy?

WOLFGANG MÜLLER: It is good to publish a lot of data and make it openly available, but of course we should not forget that some data may be very sensitive if it can be traced back to an individual. Therefore, we are very careful with such data. And personal data is not published as a matter of principle. The City of Vienna has an advisory council of experts that addresses privacy aspects and the classification of data. So far, we have not had any problems.

Of course there are also reservations, particularly when it comes to questions of how to react when people criticise the data quality. But we are seeing a cultural shift there as well, in how we deal with feedback. When feedback is seen as supportive, the departments of the City Administration have no issues with it and use it to improve their work.

What is the relationship between apps and data? You mentioned that a lot has been done and many apps have been developed. Does the city have a specific strategy in this regard?

WOLFGANG MÜLLER: The City of Vienna leads the field internationally with regard to the development of apps from its open data. We try to find out which data and which kind of apps people want. In some cases, there is an enormous demand for data that we would not have expected anyone to be interested in, such as historical data and time series – "what did this look like five years ago, how was that ten years ago?"

The City of Vienna pursues an open strategy in order to find out what people want. Our Digital Agenda is designed and implemented in a transparent and participatory way. It is an open platform in which anyone can participate, online or offline. We decided we did not want an IT strategy that was written by a few experts behind closed doors. We wanted anyone to be able to participate. And people did. We were surprised at the numbers and the diversity of participants. At our first open lab, we had about 100 participants and an incredibly constructive discussion.

The most important thing about this process was that we did not set out with a fixed idea of what the result should look like. That was a risk we were willing to take. We did have a general framework, but we did not define what kind of results we expected. That is what open innovation is about: we don't exactly know where the road will take us, and that is the key to success, because it facilitates extremely innovative and constructive cooperation.

The online city map is a very interesting tool with an enormous range of functions. It is also an important tool for the energy sector. We started out by displaying the potential for solar energy on Vienna's roofs. These days, people can also check the energy potential of ground heat, groundwater and wind at their location. What else are you planning for the online map?

WOLFGANG MÜLLER: A tool like that needs up-to-date, fully electronic georeferenced data, as is the case with our online city map, which has data on over 200 different topics. And it is going to increase in importance.

We recently received the international "Geospatial World Excellence Award" for our approach. We created an administrative map of Austria together with the other federal provinces (basemap.at). It combines the geodata of Austria's federal provinces, cities and municipalities in a single map, and it is the first national map in the German-speaking region to be made freely available worldwide as open government data. The City of Vienna was in charge of project management. Another important issue when you publish data in an online map is of course, again, privacy.

What do you think of the city's overall approach to innovation? Innovation, for me, is a solution that has not been attempted before. Innovation exists in different fields, not only in technology. Innovation is not only material; it can also be about new financing models or services. When innovations are applied, things improve.

WOLFGANG MÜLLER: I agree. Innovation is something new that is implemented and is in some way economically relevant. Often, innovation makes things easier. I'm thinking of the robot we developed together with the fire department – the innovation there is not that it has so many functions but that it is so easy to use. To be innovative, you need the courage to embark on a journey without knowing whether it will be successful.

Innovations are often created by small companies and organisations. Big players often seek inspiration from smaller ones. Is that the case for the City of Vienna as well?

WOLFGANG MÜLLER: Of course we need ideas from the outside. The City Administration has two approaches to promoting innovation: On the one hand, we can support specific developments when we award contracts. On the other hand, the city also creates innovation together with various players. One example is our Digital City initiative, where we cooperate with the IT industry and they develop entire computer programs without any particular specifications from us. Innovation happens because we support the exchange of ideas and cooperation. I believe this is an area where we as a city can be very open because we have nothing to hide.

BERND VOGL
became Head of the Energy Planning Department (MA 20) in September 2011 after working for more than 18 years at the Ministry of Environmental Affairs in the field of energy planning and innovative energy systems.

BERNHARD JAROLIM
was appointed Head of Municipal Department 25 (Urban Renewal & Inspecting Authority for Residential Buildings) in 2010. He has been working for the City of Vienna since 1995, including in the department for technical property matters.

Bernhard Jarolim

BERND VOGL: *Housing and energy planning are important topics in a growing city that aims to be a smart city. What do you think will be the great challenges of the next decade?*

BERNHARD JAROLIM: The largest challenge is surely the influx of people to Vienna; a trend we have observed for several years and which will continue in the years ahead. This increases pressure on the housing market. The increase in rents on the open housing market is above average and, unfortunately, frequently exceeds the legal thresholds. The city needs to build even more affordable housing than so far. In order to ensure that housing remains affordable, the construction of new flats will be increased by 30% by 2018 on initiative of Executive City Councillor for Housing Michael Ludwig – that is 13,000 new flats a year, 9,000 of which will be subsidised. We already build 7,000 subsidised flats a year, which is more than any other city in Europe. At the same time, we also want to maintain our high standards of quality in housing, particularly with regard to the energy balance of buildings. There is no question that housing plays an important role in whether we reach our climate and energy targets or not. This also requires the participation of the construction industry.

The City of Vienna offers subsidies to ensure that housing stays affordable. In the energy sector, we have subsidies for flats and buildings on the one hand and for renewable energy generation on the other. The latter is intended to get people to invest in photovoltaics and other green energy systems that reduce their energy costs in the long term. Which type of subsidy is better?

BERNHARD JAROLIM: We need both, we need a balance. Pitting one type of subsidy against the other is not the way to go. Vienna has struck a good balance between the two. Housing should be affordable for everyone, and when you subsidise flats, particularly in social housing, you get a good social mix and prevent the formation of ghettos, marginalisation, and only some parts of the population being able to afford to live in efficient, high-quality buildings. At the same time, however, subsidising PV installations and other power systems has a considerable advantage: people become very attached to them. Schemes where we subsidise the entire building or only parts of the system don't create that sense of ownership. It feels completely different when you personally invest in renewable energy. This subsidy scheme is a very innovative approach that I believe we could expand.

What do you think the future of housing subsidies will be considering the spending cuts the city is planning for the next years?

BERNHARD JAROLIM: The city's spending reform is currently still being developed, and the experts are determining where savings are possible. Housing is a fundamental need. A positive living environment contributes significantly to well-being and quality of life. That is probably not an area where there will be spending cuts. Quite the opposite: there will need to be investments in housing. And of course housing construction is also an enormous boost for the economy.

What kind of offers does the housing industry need from energy suppliers? Are there any things you'd like to see?

BERNHARD JAROLIM: In my view, cooperation between the housing industry and energy suppliers is very positive and forward-looking. I'm a fan of district heating, so of course I would like to see more of it, particularly in subsidised housing. I believe that we should use district heating where it is economically feasible for a variety of reasons, not least of them climate protection.
It would also be important to make sure that people living in newly constructed energy optimised buildings really understand how heating, ventilation and hot water generation work. Users are often not aware of the importance of good airing habits. Airing a flat the wrong way can cause considerably higher energy consumption and energy costs than necessary.

That makes sense. Nobody understands why the energy costs in a passive house are as high as in an old building. Do newer, more efficient buildings need a new billing system for heating costs?

BERNHARD JAROLIM: When it comes to passive houses, we need a lot more education for the inhabitants. What we are seeing is that many people move into passive houses but don't change their living habits. Remarkably, we are also seeing some people in passive houses becoming less energy conscious and, for example, using more hot water. There is a lot being done in terms of education but changing your behaviour is a process that doesn't happen overnight.
The Heating Costs Act was developed for completely different building types than the ones we are building today. In new buildings where optimum user behaviour leads to an extremely low energy demand, we need new regulations for billing. They should move away from a fixed average towards reflecting actual energy consumption. Tenants should be able to see the direct impact of their living habits on their energy bill.

We often know very little about how much energy a planned building will really consume or about the practical impact of certain energy-relevant measures. Could monitoring help?

BERNHARD JAROLIM: It is good to have data when planning new buildings and urban development and renewal measures. That way we can see how effective different measures are and which types of buildings work. In Aspern–Vienna's Urban Lakeside, we are currently collecting such data in the urban development area's new buildings. The data collected there is a good foundation for future planning, and we will also be able to benefit from the results of the large EU-subsidised urban renewal project "Smarter Together". The focus in that project is on measuring the effect of various refurbishment and renewal measures. The project shows how much is possible and from how many different points of view refurbishment can be approached. By involving the population, we are also strengthening their identification with the neighbourhood, which improves quality of life as well.
These two examples show that urban development and renewal must be approached from an even more multidisciplinary perspective than so far. It also makes sense to look at larger areas rather than individual buildings or city blocks. That also makes it easier to develop comprehensive energy concepts, place a focus on participation, or develop tailored mobility solutions. This benefits all the inhabitants of our city enormously, whether they live in subsidised housing or not.

The EU project "Smarter Together" is a good example of multidisciplinary cooperation. It involves many different project partners. How do you experience cooperation within the Vienna City Administration?

BERNHARD JAROLIM: Very good overall, because our understanding for each other has improved. One reason for that is that departments and associated organisations are exchanging more information with each other thanks to various measures. And that is happening at all levels of the city administration. The structural and spending reform of the city is another example of how a holistic approach helps us achieve our goals faster and in a more satisfactory way.

3 MILESTONES ON THE ROAD TO A SUSTAINABLE ENERGY FUTURE

COP21 – breakthrough for a new global climate protection agreement

The 21st UN climate conference was held in Paris from 30 November to 12 December 2015. For the first time, nearly all countries of the world agreed to undertake joint efforts to combat climate change. A major target set out in the agreement is to keep the increase in global average temperature well below 2°C above preindustrial levels and ideally to limit the increase to 1.5°C.

This objective can only be achieved through a number of far-reaching measures that must be implemented starting immediately. This includes reducing global net greenhouse gas emissions to 0 between 2045 and 2060. Nation states must report sufficient reduction goals. If these goals turn out to be insufficient, stricter targets will be demanded and set every five years. In the runup to the COP21 negotiations, the European Union set itself binding targets for 2030 in order to strengthen the proponents of an international agreement:

- a 40% cut in greenhouse gas emissions compared to 1990 levels
- at least a 27% share of renewable energy consumption
- at least 27% energy savings

As one result of COP21, the European Commission published a proposal with binding national targets to be met by the Member States by 2030 for the sectors not covered by emissions trading. For Austria, the target is a reduction in greenhouse gas emissions by 36% compared to 2005 levels.

Climate protection has been a priority for Vienna for many years. The Paris Agreement supports the city's efforts towards a sustainable energy system.

Successful efficiency programme

In 2006, the Vienna City Council adopted the Urban Energy Efficiency Programme (SEP). Its objective was to create a strategic framework for energy efficiency measures in Vienna by 2015 and to reduce the expected increase in energy consumption in Vienna from 12 to 7%.

The final report on the full SEP implementation period (2006 to 2015) has now been published. It shows that the objective was more than achieved. In the period under review, the documented project-related energy savings amounted to approximately 155 GWh a year. If the energy savings that could not be documented (e.g. in federal buildings and in businesses) are included, the total savings can be assumed to be considerably higher than the documented 155 GWh and certainly well above the SEP target of 180 GWh.

SEP successfully established the importance of energy efficiency in Vienna and showed that energy savings are possible everywhere. Since the adoption of SEP in 2006, the conditions for energy efficiency policy have progressed considerably at both the European and national levels. Efficiency is becoming increasingly important and measures are becoming more binding (cf. EU Energy Efficiency Directive 2012/27/EU and Federal Energy Efficiency Act). Going forward, it will be important not to slow down but to continue to focus on the systematic implementation of energy efficiency measures. A follow-up programme is already being developed with that in mind.

E-mobility strategy – more e-mobility for Vienna

The City of Vienna is preparing for the increase in e-mobility that is expected for the coming years. Electric vehicles are becoming an increasingly viable alternative to cars that run on diesel and petrol. With its e-mobility strategy, the City of Vienna is making important inroads towards expanding electromobility in the city. This includes a network of electric vehicle charging stations that will be built in Vienna in the next years. New charging technologies, improved vehicles and sinking production costs make this the ideal time to start building a citywide network of publicly accessible charging stations. Providing supply security throughout the city will hopefully contribute to reducing scepticism toward e-mobility and create an additional incentive for switching to an electric vehicle.

The charging network will be based on the citywide street lighting network, which offers ideal conditions for setting up charging stations while also reducing costs. Additional charging stations will be set up in the semi-public space and on publicly accessible private property.

With the implementation of the e-taxi project of Vienna Public Utilities, the city also shows that it is committed to investing in e-mobility. Currently, subsidy schemes are being discussed to further promote e-mobility in the course of renewals of the city's vehicle fleets.

Photo: Christian Fürthner/MA 20

Fig. 1
E-mobility in Vienna

Innovative use of waste heat – modernising the Manner factory

The government manifesto of Vienna's coalition government includes the increased use of waste heat and ground heat as sources of energy. A showcase project for the use of industrial waste heat can be found in Vienna's 17th district at the historical Manner sweets factory. It shows how, using a combination of various innovative technical solutions, businesses can act as heating energy suppliers in mixed-use areas if they are located close enough to energy consumers.

In the course of the expansion and modernisation of the factory, special emphasis was placed on more efficient energy use. Starting in autumn 2016, the waste heat from the baking process (thermal output of 1 MW) will be fed directly into the local district heating network. The heat will be used for space and water heating for 600 households and companies in the immediate vicinity of the factory. This highly efficient use of waste heat saves 1000 t of carbon dioxide annually. Some of the excess heat is also converted into cooling energy and used to cool various production processes in the factory itself.

ebsWien eco-power plant – from waste to energy

Vienna's main wastewater treatment plant is currently working on the city's largest environmental project, which is unique worldwide. By 2020, the wastewater treatment plant will be modified to double as a green power plant. The fermentation of the sewage sludge produces methane gas, which will be burned in gas-powered cogeneration plants, generating both electricity and heat.

Currently, the wastewater treatment plant uses approximately 63 GWh of electricity a year, making it one of the city's largest energy consumers. But soon, the power plant will produce 78 GWh annually, allowing it to cover the entire electricity demand of the wastewater treatment plant. The excess electricity will be fed into the public grid. The amount generated would be enough to provide power for 31,000 Viennese households for an entire year.

In addition to electricity, the power plant will also generate 82 GWh of heat a year, approximately half of which will be consumed on site. The other half will be fed into the district heating network, providing heating and hot water for some 5,000 households.

This example shows how energy efficiency and resource conservation combined with innovative measures for optimising the ratio of water to solids in the sewage sludge as well as advances in process control and measuring technology can make an important contribution to reaching the energy and climate targets.

Funding priority: renewable heat and seasonal storage

The City of Vienna aims to increase the share of renewable energy in heat production considerably from the current level of 10%. There is potential for the use of solar energy, waste heat, groundwater and near-surface ground heat in Vienna, but it remains largely untapped.

Therefore, three new funding schemes have been launched to encourage the installation of systems that produce or store renewable heat. Since the beginning of March 2016, the city has been subsidising solar heating systems, heat pumps in residential buildings that utilise ambient heat, systems for the thermal use of groundwater and ground heat, and seasonal heat storage systems (for waste heat and renewable energy) that help balance the load between the different times of production and use of heat. Vienna is the first Austrian province to subsidise seasonal storage combined with anergy grids, making it a trailblazer in the promotion of these innovative technologies.

The city provides financial support for investment costs for various renewable heating and storage technologies. This mitigates part of the high initial investment costs, and the use of these technologies will lower heating costs enormously for decades to come.

For more information, please visit: www.energieplanung.wien.at/foerderungen

Photo: Christian Fürthner/MA 20

Fig. 2
Aspanggründe/ Eurogate

Switching to LED street lights

Vienna's entire street lighting network will be switched over to climate-friendly LED technology by 2020. The first LED street lights were installed in parks and along footpaths and cycle paths in 2009. The new LED technology improves lighting quality considerably while reducing electricity consumption by 50%.

LED lamps also increase traffic safety at dangerous crossings. Another advantage compared to conventional lamps is their long service life: LED lamps can be used twice as long as conventional bulbs, 12 years at minimum. This reduces the amount of maintenance required, which in turn eases the strain on the city's budget.

They are financed with a so-called lighting contracting model. Vienna's energy supplier Wien Energie, Vienna Public Utilities, and Municipal Department 33 – Public Lighting agreed on an amortisation contracting model, where the contractor pre-finances the investments, which are then refinanced through the energy savings achieved during operation.

By switching to LED technology, the City of Vienna is not only contributing to climate protection but also improving the city's liveability with better lighting.

Fig. 3
Switching to LED technology

Photo: Christian Fürthner/MA 33

Quality assurance for energy performance certificates

Like the federal provinces of Vorarlberg (EAWZ), Salzburg, Styria and Carinthia (all three ZEUS), Vienna has now also introduced an energy performance certificate database. In January 2016, the City of Vienna introduced the database WUKSEA, in which all energy performance certificates issued for Viennese buildings must be registered. The aim of registration is to improve quality assurance and to ensure that the data in the certificates is correct and up to date.

The legal basis for this is the Energy Performance Certificate Database Ordinance of 22 June 2015 as well as Art. 118a of the Vienna Building Code. Not only do energy performance certificates have to be available electronically, they also have to be registered in WUKSEA. The City of Vienna provided a software interface for the upload of certificates and offers software support. Technical and software support is available from Municipal Departments 37 (Building Inspection) and 25 (Urban Renewal & Inspecting Authority for Residential Buildings; Group "Neubau und Gebäudetechnik").

For more information, please visit:
https: //www.usp.gv.at/Portal.Node/usp/public/content/online_verfahren/wuksea/171236.html

4 MUNICIPAL DEPARTMENT 20 – ENERGY PLANNING: SHAPING VIENNA'S ENERGY FUTURE

Between 1 July 2015 and 30 June 2016, the following projects and measures were implemented or continued:

Energy ideas for a smart city

The interest in energy and climate protection is growing. More and more people, for example, want to install their own photovoltaic system, and the demand for renewable energy and the need for more information on energy efficiency are rising constantly.

1. New funding priorities in 2015
The promotion of innovative technologies contributes significantly to climate protection. 2015 brought fundamental improvements to subsidies for renewable energies. The green electricity subsidy is now available not only for photovoltaics but also for so-called hybrid systems (which produce both electricity and heat from sunlight) and electrical storage systems.

Two additional funding schemes aim to increase energy efficiency. These new funding schemes provide attractive incentives that support both energy efficiency programmes and the planning of highly efficient buildings. The latter is designed to increase the share of zero-energy and energy-plus buildings in Vienna.

For more information, please visit:
www.energieplanung.wien.at/foerderungen

Fig. 4
Aspanggründe/ Eurogate

Photo: Christian Fürthner/MA 20

Additionally, the funding of renewable heating was reformed. Three new funding schemes were launched to promote the installation of systems that produce or store renewable heat. Vienna is at the forefront of innovation with its decision to subsidise seasonal storage systems combined with anergy grids. Anergy grids use low-temperature heat (e.g. waste heat from waste water or data centres). Vienna is the first Austrian province to support this innovation financially.

2. Generating your own solar power
The online tool "Sonnenklar" allows users to calculate how much PV electricity they would use and to determine the optimum size for a PV system. The tool is intended for non-experts who have or want to buy a PV system and want to use the majority of the electricity it generates themselves. The calculator was commissioned by Municipal Department 20 – Energy Planning and implemented by the Federal Association Photovoltaic Austria. It is available for free at: http://pvaustria.at/sonnenklar_rechner/

Fig. 5
PV panels

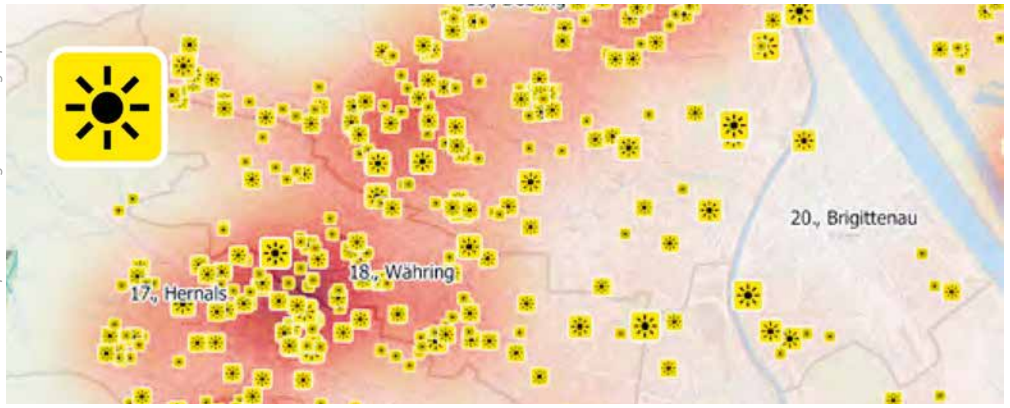
Photo: Christian Fürthner/MA 20

3. Open access to energy data
Energy data is of immense importance when planning buildings and urban development areas. Numerous energy-related datasets have been published in the open government data catalogue of the City of Vienna (www.data.wien.gv.at). This includes energy balances, data on energy generation, and cartographic data on the potential of various energy sources.

4. Discovering alternative energy sources on the city map
Which power plants generate energy for our city? How many of them use renewable energy sources? What is the energy potential of my house or property? The energy map has the answers to all these questions. It also shows the locations of innovative model projects (e.g. energy-plus houses). The maps are available online at: www.energieplanung.wien.at/stadtplan

Fig. 6
Section of the map showing subsidised solar thermal power plants

Source: https://www.wien.gv.at/umweltgut/public/



Solar thermal plants for energy generation
The map shows all solar thermal power plants in the city that are subsidised by the City of Vienna. It provides information on the collector area and date of construction for each plant. The size ranges from small plants (less than 10 m²) to medium-sized (10 to 25 m²) to larger (25 to 50 m²) and very large plants (over 50 m²). The map shows where there are larger concentrations of solar thermal power plants.

5. Energy literacy certificate wins 2015 Climate Protection Award
The 2015 Climate Protection Award was awarded to the energy literacy certificate "energieführerschein", which teaches young people how to conserve energy. The energy literacy course was developed by "die umweltberatung Wien" with support from Municipal Departments 20 and 22. The number of young people who have gained this additional professional qualification includes 160 apprentices of the Vienna City Administration. In mid-2016, a gaming app was launched that makes learning about energy saving fun. The questions from the energy literacy certificate test were converted into a quiz and incorporated into an app called "Rette Deine Insel" ("Save your island"). The players start on a dirty island and must answer questions to clean it. The number of questions increases with the level of difficulty. Successfully answering questions makes the island cleaner and prettier. At the same time, players learn about saving energy at work and at home. The app is free and available for Android and iOS: http://www.umweltberatung.at/efsapp

Fig. 6
2015 Climate Protection Award ceremony; left to right: Andrä Rupprechter, Markus Piringer, Bernd Vogl, Claudia Reiterer, Barbara Frischmuth, Alexander Wrabetz

Photo: ORF/Thomas Jantzen

Data & research

Municipal Department 20 – Energy Planning collects data on energy potentials in different locations and conducts studies on energy-related topics on a regular basis. The results are intended to provide the city's decision makers with the necessary information for their decisions and facilitate the implementation of long-term goals of the Smart City Wien Framework Strategy.

The studies presented below and many more are available for download free of charge at: www.energieplanung.wien.at/publikationen

1. Potential for small wind power in Vienna
The City of Vienna commissioned the Central Institute for Meteorology and Geodynamics to develop a wind potential map for the use of small wind turbines in the Vienna region. Vienna has favourable wind conditions, particularly in the northern and northeastern parts of the 21st and 22nd districts as well as on the southern edges of the 10th, 11th and 23rd districts.

Photo: Christian Fürthner/MA 20

Fig. 7
Small wind turbine

2. Energy flows in buildings
This study examined the actual energy use of 20 representative office buildings in Vienna and sought to answer the following questions: How much energy does an office building really use? Where does the energy come from and what is it used for?
A comparison of the consumption data with the target value specified in the energy performance certificates showed that 14 out of 17 buildings exceeded the specified values and only three buildings consumed less than specified. Since office buildings are responsible for

a considerable part of Vienna's total energy consumption, it is important to push for more sustainable energy supply in this area as well.

3. Smart Block – refurbishing better together
Vienna has a large share of old buildings. Refurbishing them requires solutions that reduce energy consumption and carbon dioxide emissions considerably. The potential for reduction is particularly high in blocks of several houses. The project "Smart Block" demonstrates innovative approaches on a specific block of houses from the latter half of the 19th century. The analysis shows that when several buildings are refurbished at the same time, it not only increases energy efficiency but also creates opportunities for more independent energy generation and supply as well as new mobility concepts.

EU projects

The City of Vienna is involved in a number of EU projects. This not only brings EU funding to the region but also strengthens the city's energy know-how and makes external expertise available to the city.

1. URBAN LEARNING – collective learning for improved governance
Municipal Department 20 – Energy Planning is participating in the EU research project URBAN LEARNING. Coordinated by the Energy Center Wien as lead partner, the project involves energy agencies and other partners from Vienna, Berlin, Stockholm, Amsterdam/ Zaanstad, Paris, Warsaw and Zagreb. It aims to improve the institutional capacity of local authorities for integrated urban energy planning, particularly against the backdrop of new challenges of the EU Buildings Directive and the Renewables Directive, technological and market changes, and the pressure to provide sufficient affordable housing. The focus is on innovative technological solutions, tools and good governance.

2. SMARTER TOGETHER – smart urban renewal
Vienna was awarded the EU project "SMARTER TOGETHER" together with Munich and Lyon. It is a modern smart urban renewal project that will, in Vienna, focus on Simmering, the 11th district. The project addresses the question of how an area with existing housing stock can be converted to a smart city standard. The project was launched in February 2016. It will run for three years, which will be followed by a two-year evaluation phase. "SMARTER TOGETHER" aims to demonstrate the benefits of approaching urban renewal from an interdisciplinary point of view. This allows a holistic approach to renewing energy concepts, which includes public participation and mobility aspects. Together, the thermal rehabilitation of housing estates, sustainable mobility and an increased use of green renewable energy will improve the quality of life in the neighbourhood considerably.

5 ENERGY – FROM GENERATION TO USE

a. An overview of the main concepts

AMBIENT HEAT	...includes near-surface and deep geothermal energy and solar energy
BIOGENIC FUELS	...includes the organic part of domestic waste, wood pellets, wood briquettes, wood chippings, charcoal, waste liquor, landfill gas, sewer gas, biogas, bioethanol, and biodiesel.
BLI (BUNDESLÄNDER LUFTSCHADSTOFF INVENTUR)	... a survey conducted by the Environment Agency Austria to analyse the development of greenhouse gases and selected air pollutants in Austria's federal provinces.
CO_2 EQUIVALENT	...makes it possible to compare different greenhouse gases. CO_2 is a gas that is created by combustion processes, including similar processes like respiration. There are also other greenhouse gases, such as methane or nitrous oxide. Different types of gases do not all contribute equally to the greenhouse effect. For example, methane has 21 times the climate impact of carbon dioxide, which corresponds to a CO_2 equivalent of 21.
COGENERATION/ COMBINED HEAT AND POWER (CHP)	...is the cogeneration of electrical energy and heat, for example in a heating plant.
COMBUSTIBLE WASTE	...includes industrial waste and the non-renewable share of domestic waste.
CONVERSION LOSSES	...refers to the energy that is lost during the conversion of primary energy to secondary or useful energy.
ECOBUSINESSPLAN VIENNA	...is the environmental service package of the City of Vienna for enterprises. It includes professional advice and consulting, support with the practical implementation of measures, legal certainty and effective PR. For more information, please visit https://www.wien.gv.at/umweltschutz/oekobusiness/
ENERGY FLOW CHART	...is a chart depicting the energy flows within a given system, such as the City of Vienna in one year.
FINAL ENERGY	...is the energy available to end users, e.g. in the form of electricity, district heating, petrol, diesel, wood pellets or natural gas. They can use this energy directly or transform it further.
FROST DAY	...is a day on which the minimum temperature goes below 0°C.

GROSS FINAL ENERGY CONSUMPTION ...is the energy available after conversion but before distribution to end users. It is used to calculate the share of renewables at EU level. (cf. Directive 2009/28/EC)

GROSS INLAND ENERGY CONSUMPTION (GIEC) ...is the energy available in the city. It is the difference between imported and exported energy (net imports) and the energy generated in the city itself.

HEATING DEGREE DAYS ...are based on an indoor temperature of 20°C and a base temperature (exterior temperature at which the building is heated) of 12°C. This is designated as HDD20/12. The number of heating degree days is the sum of the difference between indoor and mean outdoor temperature on all heating degree days over the course of a year and is given as Kelvin x days (Kd).

HEATING PLANT ...is a system for the centralised generation of heat for water and space heating or for use in industrial processes.

HOT DAY ...is a day on which the maximum temperature is at least 30°C.

HYBRID PROPULSION/ HYBRID CAR ...a propulsion system or vehicle that uses a combination of different technologies. In this report, the term is used for propulsion systems that combine petrol and electricity or diesel and electricity.

ICE DAY ...is a day on which the maximum temperature is below 0°C.

KILOWATT PEAK (KWP) ...is a non-standardised value that describes the peak power of a solar module.

KLIP ...is Vienna's climate protection programme.

KLIP BALANCE CALCULATION METHOD ...is the basis for all calculations in Vienna's climate protection programme (KLiP). It is the results of BLI minus emissions trade and minus vehicle emissions that cannot be attributed to Vienna. The vehicle emissions that cannot be attributed to Vienna are calculated as the difference between the emissions caused by traffic in BLI and the Austrian emission inventory emikat.at.

OTHER TYPE OF PROPULSION ... in this report, this refers to propulsion systems that use liquid gas or hydrogen (fuel cells) as well as hybrid systems that combine petrol and liquid gas or petrol and natural gas.

PRIMARY ENERGY ...is the energy form or energy source in its initial state. This may be a fuel (e.g. coal, wood, natural gas, crude oil) or energy from the sun, wind or ambient heat. Primary energy can usually only be used after conversion into another form of energy.

PV AREA ...this report uses photovoltaic surface area as a unit of energy measurement. 6.5 m^2 of PV area correspond to 1,000 kWh.

SECONDARY ENERGY ...is the energy that is the result of the conversion of primary energy. This may be wood pellets, diesel fuel or electrical energy.

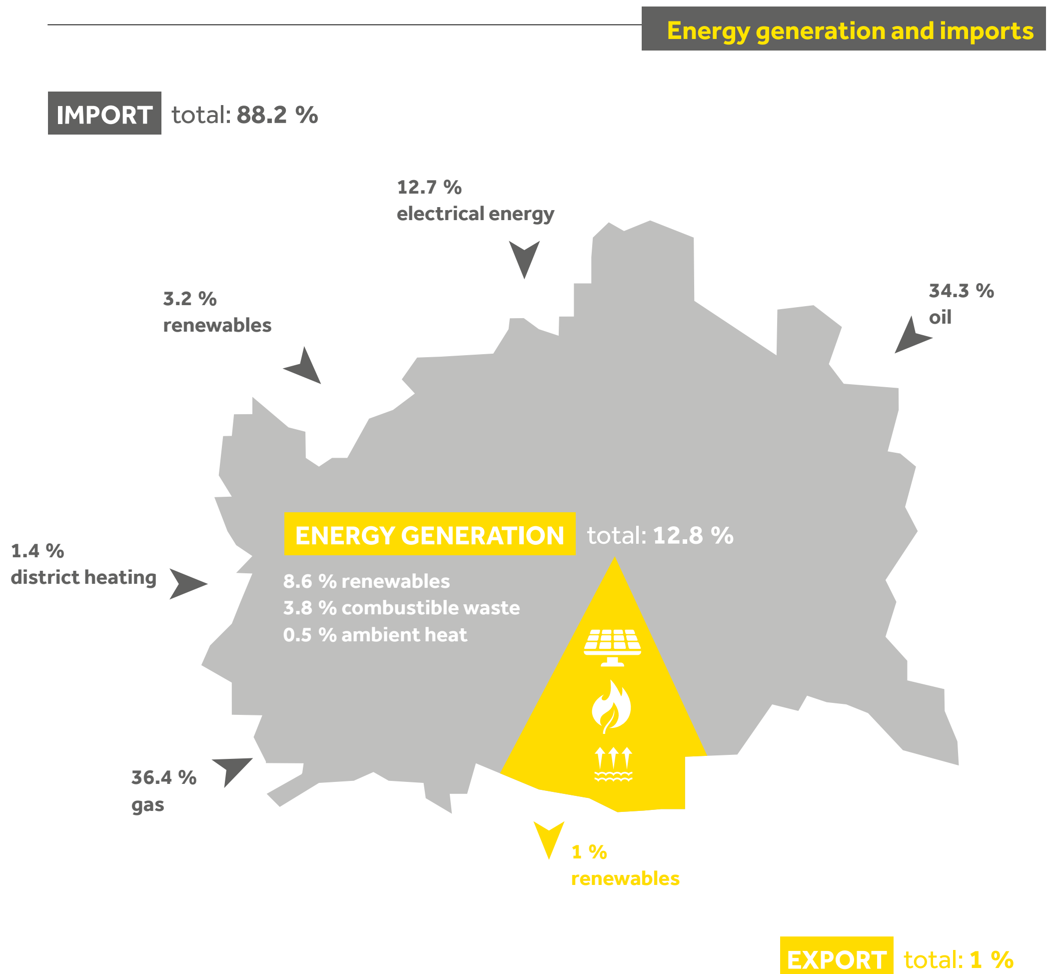
SUMMER DAY ...is a day on which the maximum temperature is at least 25°C.

TRANSMISSION LOSSES ...refers to the energy that is lost in transmission from the source, e.g. the power plant, to the final consumer. This includes the energy use of the energy sector, transport losses and non-energy use.

USEFUL ENERGY ...is the energy that is actually used for heating, lighting, mechanical work, etc.

WEATHER-CORRECTED DATA ...corrects the differences between years caused by different weather conditions. As a result, the energy consumption of different years is shown as it would have been had the weather been the same.

Fig. 8
Distribution of energy generation and energy imports in Vienna by source



b. How where we live influences our energy consumption

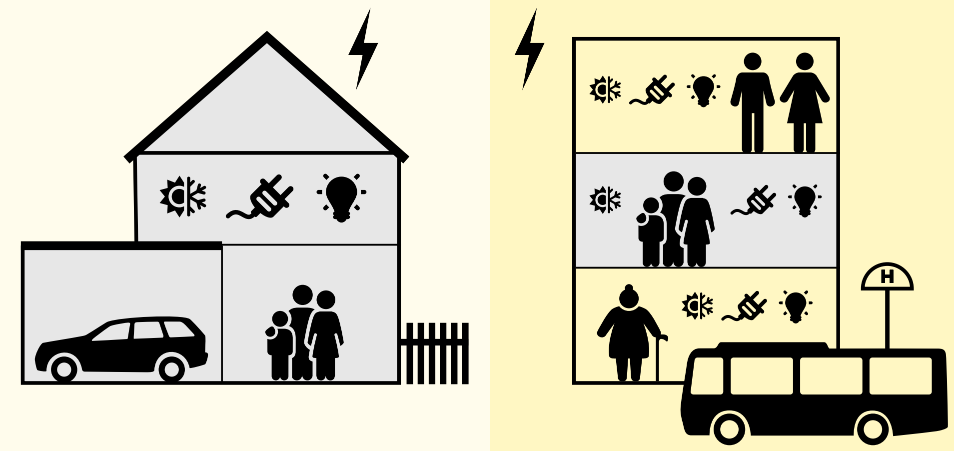
A city flat or a house in the countryside? Does where you live make a difference in terms of energy consumption? Yes! On average, living in the outer parts of the Vienna conurbation (in the adjoining provinces of Lower Austria and Burgenland) consumes approximately 50% more energy than living in the city, although this may differ for individual households.

What causes these differences in energy consumption? A major factor is that the share of detached houses is higher in rural areas than in the city (55% in Lower Austria and Burgenland compared with 9% in Vienna). An average house consumes more heating energy than a flat. This is mainly due to the larger size: a single-family detached house has an average size of 115 m², while a flat has 75 m² on average. Detached houses also have a less compact construction style, increasing heating energy demand by approximately 15%.

At the same time, living in suburban and rural areas consumes approximately 80% more energy for mobility than living in the city, which is mainly due to longer daily trips and a higher rate of car ownership (1.5 versus 0.8 in the city).

Fig. 9
Energy consumption and PV area required for an average household in Vienna vs. the suburbs

Average household 2014



kWh/household

	SUBURBS	VIENNA
space heating	13,200	7,400
hot water & cooking	3,700	2,700
appliances & lighting	2,500	2,100
transportation	10,900	5,300
total	**30,300**	**17,500**

PV area in m²

c. Energy flow chart of the City of Vienna

How much energy is needed to run a whole city? What enormous energy flows move through the city and where are they used? The energy flow chart of the City of Vienna answers these questions.

It shows how much energy is required to supply the city (40,648 GWh), where that energy is transformed, and where it is finally used.

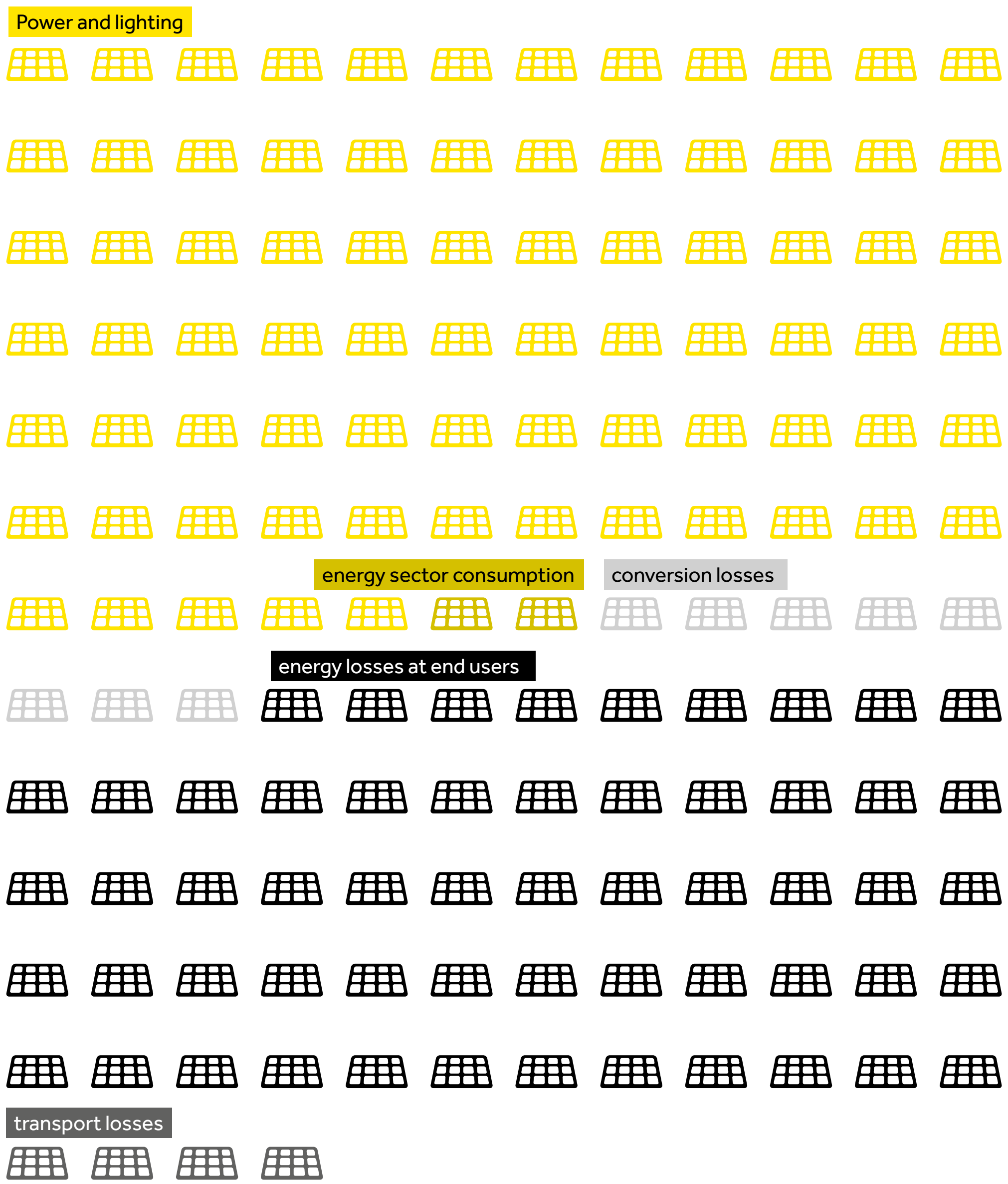
The chart shows a clear dominance of fossil energy sources (36% natural gas and 32% fuels) in the city's energy mix. Approximately half of the natural gas is converted into electricity and district heating. Fuels and mineral oils (petrol, diesel, and other petroleum products), on the other hand, are used nearly exclusively by the largest consumption sector, transportation. The energy flow chart also shows energy losses, which amount to over 20,000 GWh or 48% of gross inland energy consumption. These losses occur during different phases of the energy flow, with approximately 3,850 GWh lost before arriving at the end user (conversion losses, transport losses, etc.) and approximately 15,650 GWh losses in end-user consumption.

The enormous amounts of energy of the energy flow chart have been converted into PV surface area to show how much PV area is needed for the average person to live in the city and to show how much PV area would be needed to supply the entire city.

Fig. 10
Energy flow chart of the City of Vienna 2015, based on data from 2015 [EFB]
Source: Wien Energie

Fig. 11
Average energy consumption of one Viennese resident in PV area

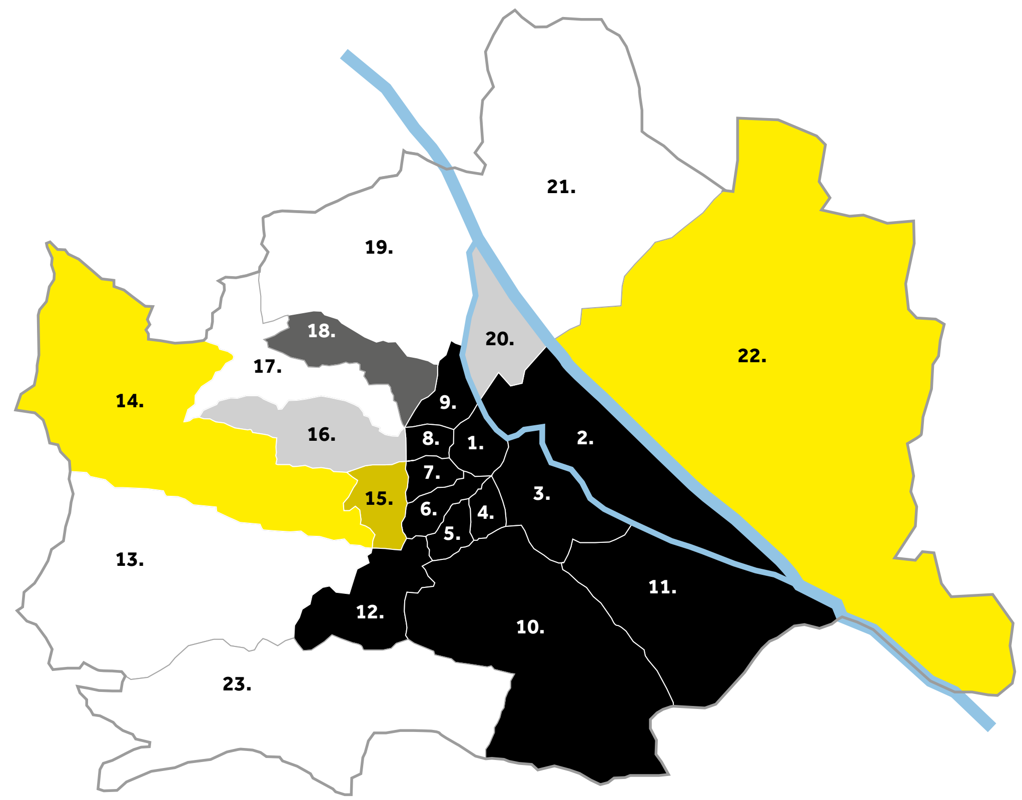
Energy consumption of one person in PV area



The enormous amounts of energy of the energy flow chart have been converted into PV surface area. 1 unit of PV area has a size of 6.5 m^2 and generates 1,000 kWh energy. In 2015, every inhabitant of Vienna would have needed 148 PV units to fuel their lifestyle. Out of these 148 units, 19 are provided from within Vienna and 129 have to be imported. Only 77 of these PV area units (shown in yellow) are consumed as useful energy, the rest are lost in different phases of the energy flow. 2 PV area units (dark yellow) are consumed by the energy sector itself, 4 (dark grey) are transport losses on the way to the final consumer, and 8 PV area units (light grey) are conversion losses from converting energy from one form to the other (e.g. biomass to district heating). The largest losses, 57 PV area units (black) are caused by final consumers.

Fig. 12
Energy consumption and losses in Vienna in PV area

Vienna's energy flows in PV area



In order to provide all energy used in Vienna, two thirds of the city's surface would have to be covered with PV panels. The energy sector would consume all the energy generated on an area the size of the 15th district (dark yellow), the 18th district would be needed to compensate transport losses (light grey) and the 16th and 20th district would cover conversion losses (dark grey). In order to cover the losses at final consumers (black), districts 1 through 12 would have to be completely covered with PV installations. An area the size of the 14th and the 22nd district would be needed to provide the useful energy (yellow).

6 MONITORING INDICATORS FOR THE SMART CITY WIEN FRAMEWORK STRATEGY

The adoption of the Smart City Wien Framework Strategy in June 2014 was an enormous step towards sustainable energy supply through resource conservation and intelligent use of resources. The strategy defined energy-relevant targets for different areas, such as efficient energy use, renewable energy sources, mobility, and buildings.
This chapter presents indicators for all of these energy-related targets that will help monitor progress towards reaching these objectives. Indicators that are not directly related to the Smart City Wien Framework Strategy are presented in chapter 2.

a. Emissions per capita

One of the energy-related objectives defined in the Smart City Wien Framework Strategy chapter "Highest possible resource preservation" is:
Reducing per capita greenhouse gas emissions in Vienna by at least 35% by 2030 and 80% by 2050 (from 1990 levels).

Table 1.1
Greenhouse gas emissions per capita in Vienna in tonnes of CO2 equivalents
Sources: [BLI 2013] and [emikat.at 2013]

t CO_2 equivalents per capita	1990	1995	2000	2005	2010	2012	2013	Change [%] base year 1990
Emissions according to KliP method	3.8	3.6	3.1	3.2	2.9	2.8	2.8	−26.1 %

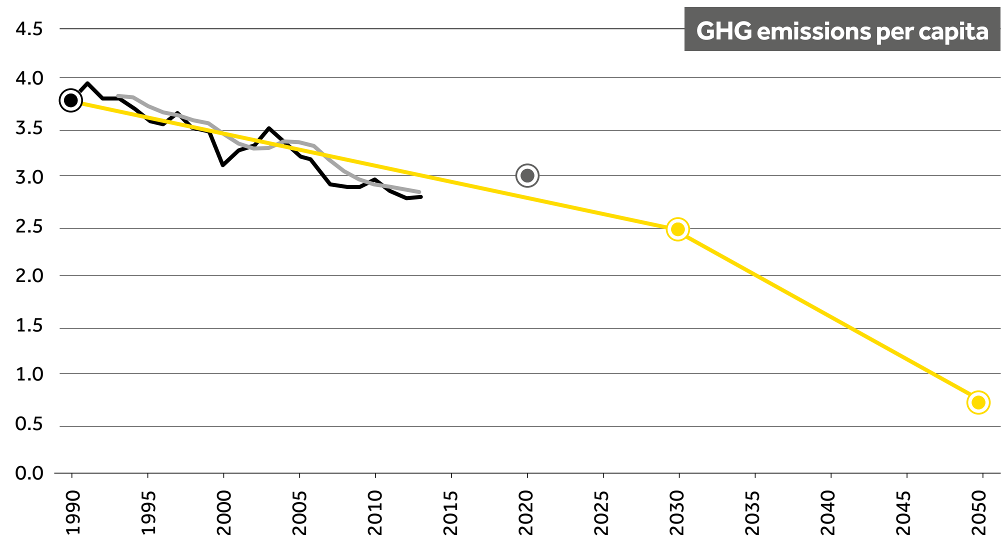


Fig. 1.1
Greenhouse gas emissions per capita in Vienna in tonnes of CO2 equivalents
Sources: [BLI 2013], [emikat.at 2013] and [SCWR]

Note:
The emissions calculated using the KliP balance calculation method are the basis for all calculations for Vienna's climate protection programmes (KLiP I and KLiP II).
The trend line is included to mitigate deviations caused by weather and leap years.

b. Final energy consumption per capita

One of the energy-related objectives defined in the Smart City Wien Framework Strategy section "Efficient energy use and renewable energy sources" is:
Increasing energy efficiency and decreasing final energy consumption per capita in Vienna by 40% by 2050 (from 2005 levels), reducing per capita primary energy input from 3,000 to 2,000 watt.[1]

Table 1.2
Final energy consumption per capita in Vienna
Sources: [Energiebilanz 2014] and [Bevölkerung]

kWh per capita	1990	1995	2000	2005	2010	2013	2014	Change [%] base year 2005
Final energy consumption per capita	18,486	20,931	21,680	24,211	23,704	22,513	20,825	−13.98 %

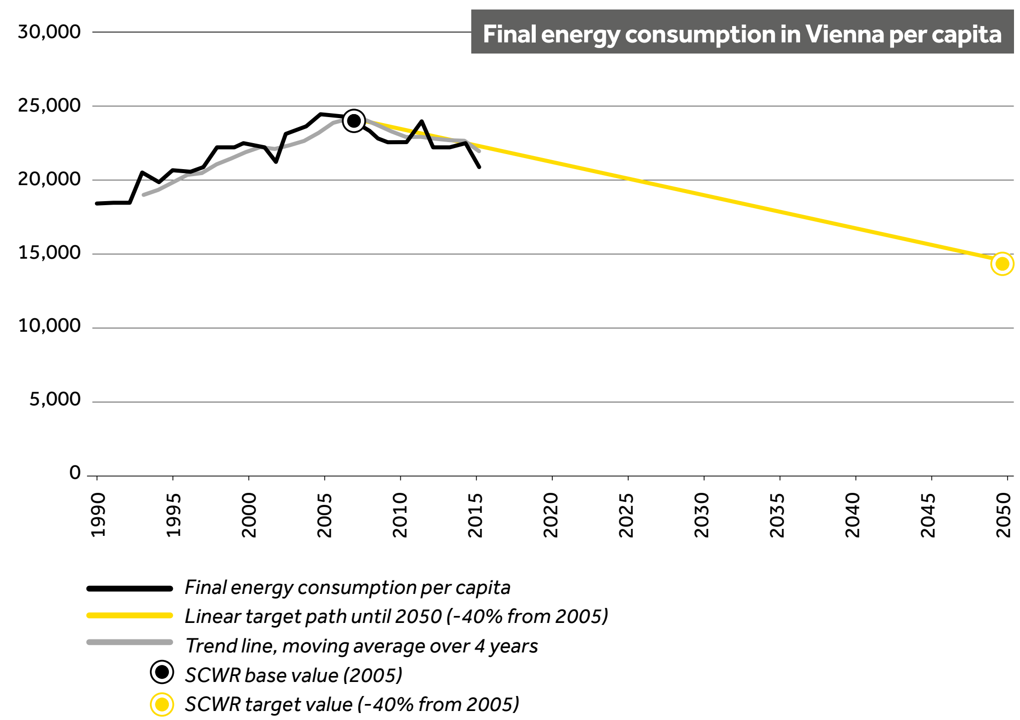


Fig. 1.2
Final energy consumption per capita in Vienna, 1990 – 2014, SCWR target
Sources: [Energiebilanz 2014], [Bevölkerung] and [SCWR]

Note:
The trend line is included to mitigate deviations caused by weather and leap years.

[1] This target as well as all the following climate and energy targets in this chapter can only be achieved if the activities of the City of Vienna receive support in the form of suitable framework conditions by the federal government and the EU, including the consideration of early actions.

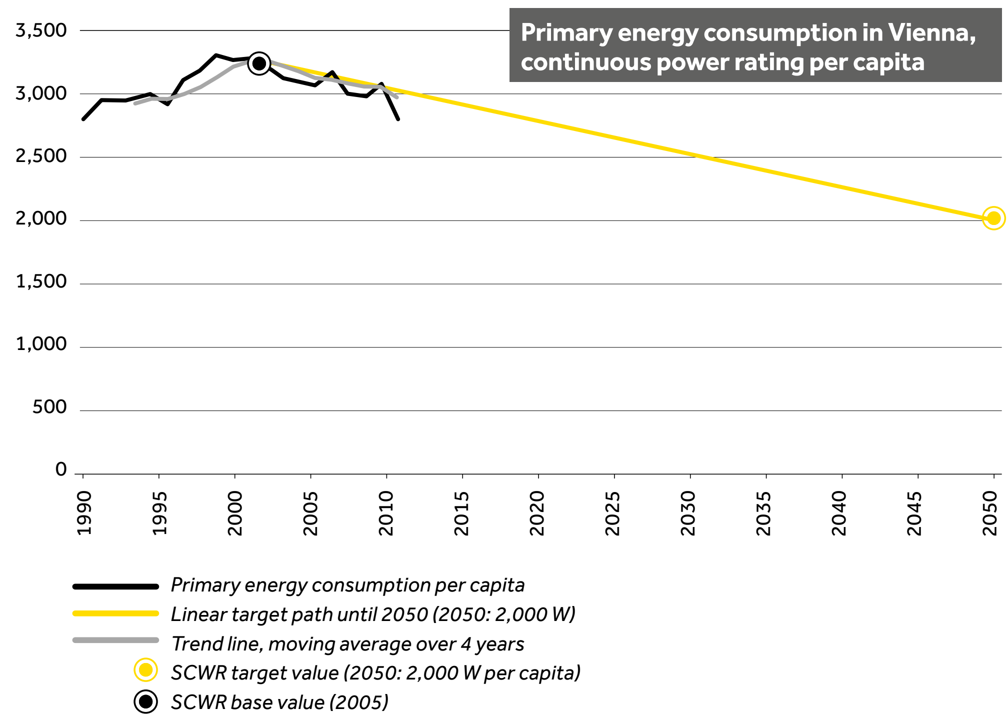
c. Primary energy consumption per capita

One of the energy-related objectives defined in the Smart City Wien Framework Strategy section "Efficient energy use and renewable energy sources" is:
Increasing energy efficiency and decreasing final energy consumption per capita in Vienna by 40% by 2050 (from 2005 levels), reducing per capita primary energy input from 3,000 to 2,000 watt.

Table 1.3
Primary energy consumption in Vienna as continuous power rating per capita
Sources: [Energiebilanz 2014], [Bevölkerung], [SCWR], [AEA], [MA 37] and [OIB]37 und OIB

W per capita	1995	2000	2005	2010	2013	2014	Change [%] base year 2005
Primary energy consumption per capita	2,833	2,940	3,286	3,172	3,062	2,831	−13.8 %

Fig. 1.3
Primary energy consumption in Vienna as continuous power rating 1995–2014, SCWR target
Sources : [Energiebilanz 2014], [Bevölkerung], [SCWR], [AEA], [MA 37] and [OIB]



Note:
Primary energy consumption is calculated based on final energy consumption for Vienna and conversion factors (AEA, MA 37, OIB). The Swiss method of the 2,000-watt society cannot yet be applied exactly. The method is being developed further.
The trend line is included to mitigate deviations caused by weather and leap years.

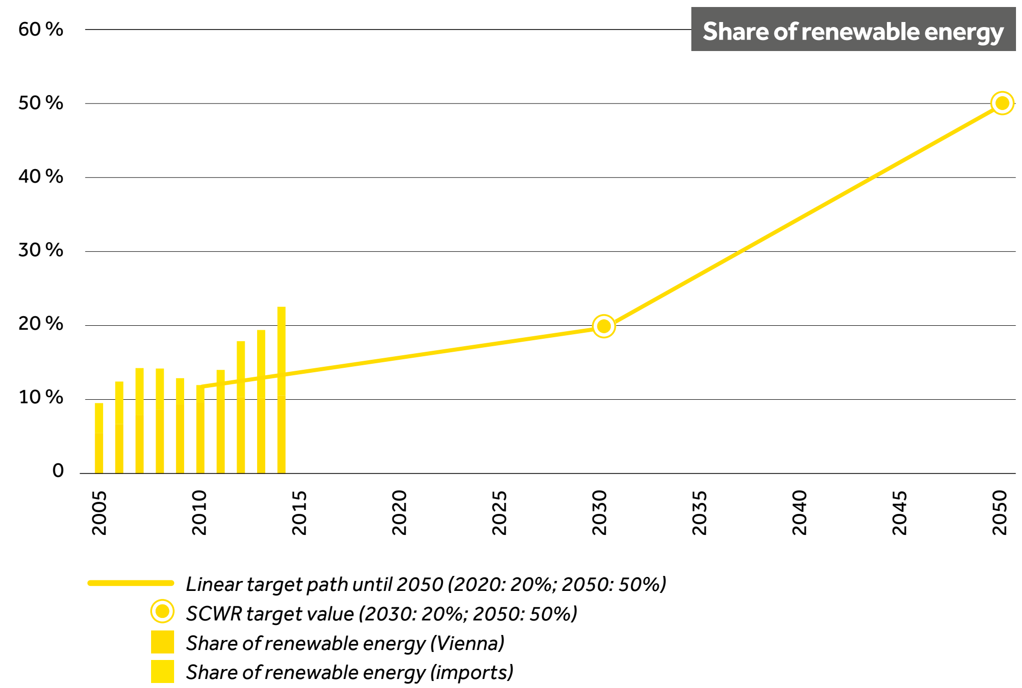
d. Share of renewable energy in gross final energy consumption

One of the energy-related objectives defined in the Smart City Wien Framework Strategy section "Efficient energy use and renewable energy sources" is:
In 2030, over 20%, and in 2050, 50% of Vienna's gross energy consumption will be covered from renewable sources[2].

Table 1.4
Share of renewable energy in gross final energy consumption in Vienna pursuant to EU Directive 2009/28/EC
Sources: [Energiebilanz 2014], [Strommarktbericht e-control] and [SCWR]

GWh	2005	2010	2013	2014	Change [%] base year 2005
Renewable energy in Vienna	2,305	4,078	4,193	4,091	+77,5 %
Imports of renewable electrical energy	1,673	985	3,778	4,615	+175.8 %
Gross final energy consumption in Vienna	41,352	41,956	40,785	38,356	−7.2 %
Renewable energy in Vienna	9.6 %	12.1 %	19.5 %	22.7 %	+135.9 %

Fig. 1.4
Share of renewable energy in gross final energy consumption in Vienna pursuant to EU Directive 2009/28/EC, 2005–2014, SCWR target
Sources: [Energiebilanz 2014], [Strommarktbericht e-control] and [SCWR]



Note:
The import of renewable electrical energy is calculated based on the amount imported according to the energy balance of Statistics Austria and the share of renewables in the Austrian electricity market according to the electricity market report of energy market regulator e-control.

[2] These do not necessarily have to be located in the city itself.

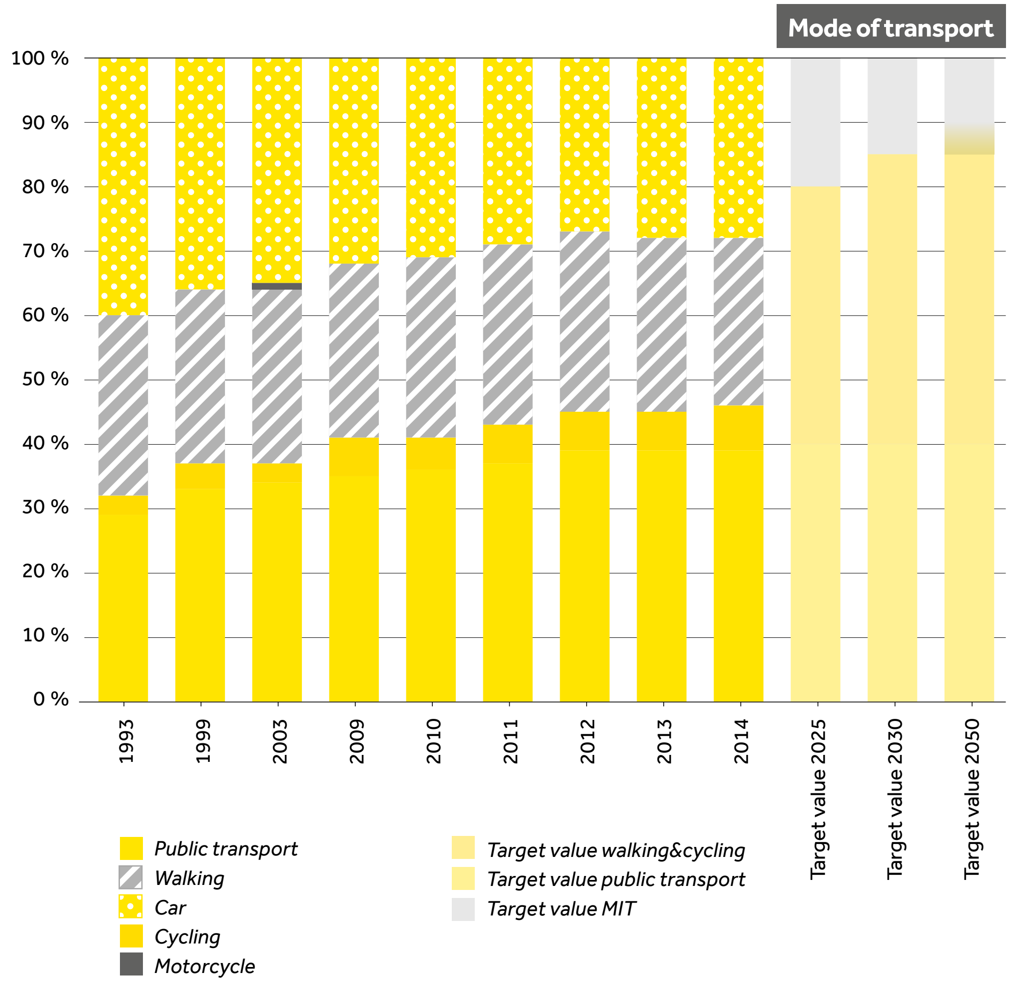
e. Choice of transportation

One of the energy-related objectives defined in the Smart City Wien Framework Strategy section "Resource-conserving mobility" is:
Strengthening CO_2-free modes of transportation (walking and cycling), maintaining the high share of public transport and decreasing motorised individual traffic (MIT) in the city to 20% by 2025, to 15% by 2030, and to markedly less than 15% by 2050.

Table 1.5:
Modes of transport in Vienna
Source: [Wiener Linien]

Mode of transport	1993	1999	2003	2009	2010	2012	2013	2014	Change [%] base year 2010
Bicycle	3	4	3	6	5	6	6	7	+40.0 %
Motorcycle	0	0	1	0	0	0	0	0	
Public transport	29	33	34	35	36	39	39	39	+8.3 %
Car	40	36	35	32	31	27	28	28	–9.7 %
Walking	28	27	27	27	28	28	27	26	–7.1 %

Fig. 1.5:
Modes of transport in Vienna, 1993–2014
Sources: [Wiener Linien] and [SCWR]



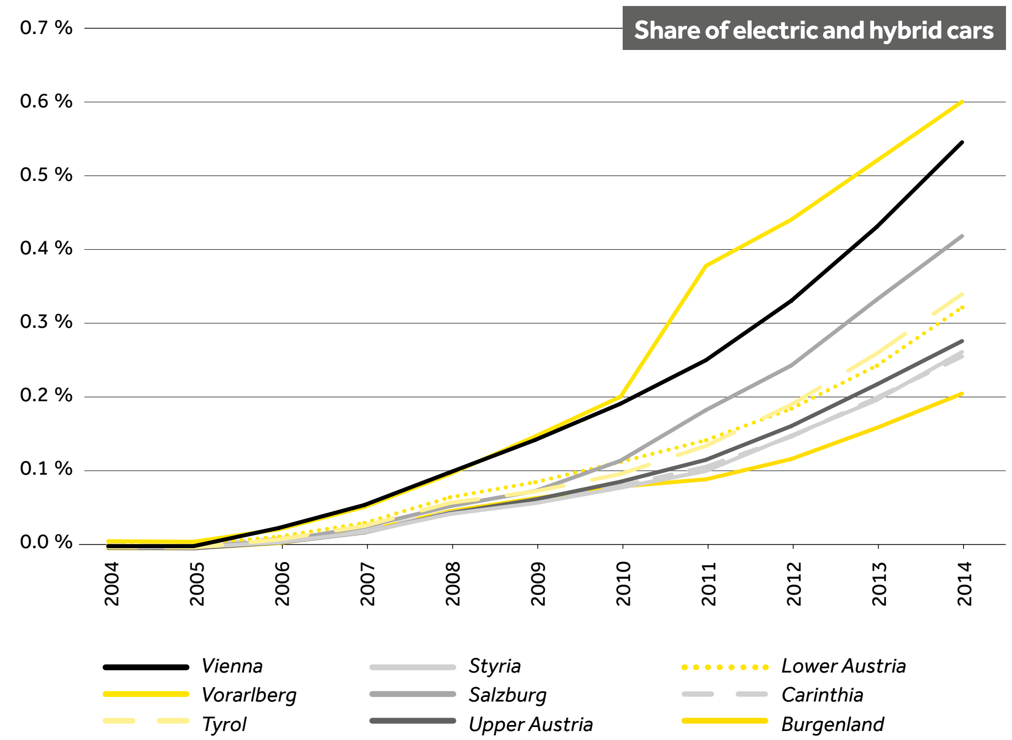
f. Share of electric and hybrid cars

One of the energy-related objectives defined in the Smart City Wien Framework Strategy section "Resource-conserving mobility" is:
By 2030, the largest possible share of MIT is to be shifted to public transport and non-motorised types of traffic or should make use of new propulsion technologies (e.g. electric vehicles). By 2050, all motorised individual traffic within the municipal boundaries is to operate without conventional propulsion technologies.

Table 1.6
Share of electric and hybrid cars by federal province
Source: [KFZ-Bestand]

Share of electric and hybrid cars	2005	2010	2013	2014
Burgenland	0.001	0.083	0.161	0.207
Carinthia	0.005	0.084	0.201	0.256
Lower Austria	0.005	0.115	0.244	0.321
Upper Austria	0.001	0.089	0.219	0.276
Salzburg	0.003	0.117	0.331	0.416
Styria	0.002	0.081	0.198	0.262
Tyrol	0.002	0.099	0.260	0.339
Vorarlberg	0.009	0.202	0.515	0.594
Vienna	0.003	0.193	0.427	0.540

Fig. 1.6
Share of electric and hybrid cars by federal province, 2004-2014
Source: [KFZ-Bestand]



Note:
Target for 2050: 100%

g. Share of electric and hybrid lorries

One of the energy-related objectives defined in the Smart City Wien Framework Strategy section "Resource-conserving mobility" is:
By 2030, commercial traffic originating and terminating within the municipal boundaries is to be largely CO_2-free.

Table 1.7
Share of electric and hybrid lorries by federal province
Source: [KFZ-Bestand]

Share of electric and hybrid lorries	2005	2010	2013	2014
Burgenland	0.007	0.024	0.056	0.060
Carinthia	0.012	0.041	0.243	0.257
Lower Austria	0.010	0.026	0.157	0.192
Upper Austria	0.005	0.010	0.109	0.126
Salzburg	0.021	0.015	0.110	0.133
Styria	0.006	0.016	0.146	0.206
Tyrol	0.003	0.012	0.128	0.147
Vorarlberg	0.012	0.027	0.135	0.157
Vienna	0.015	0.031	0.218	0.332

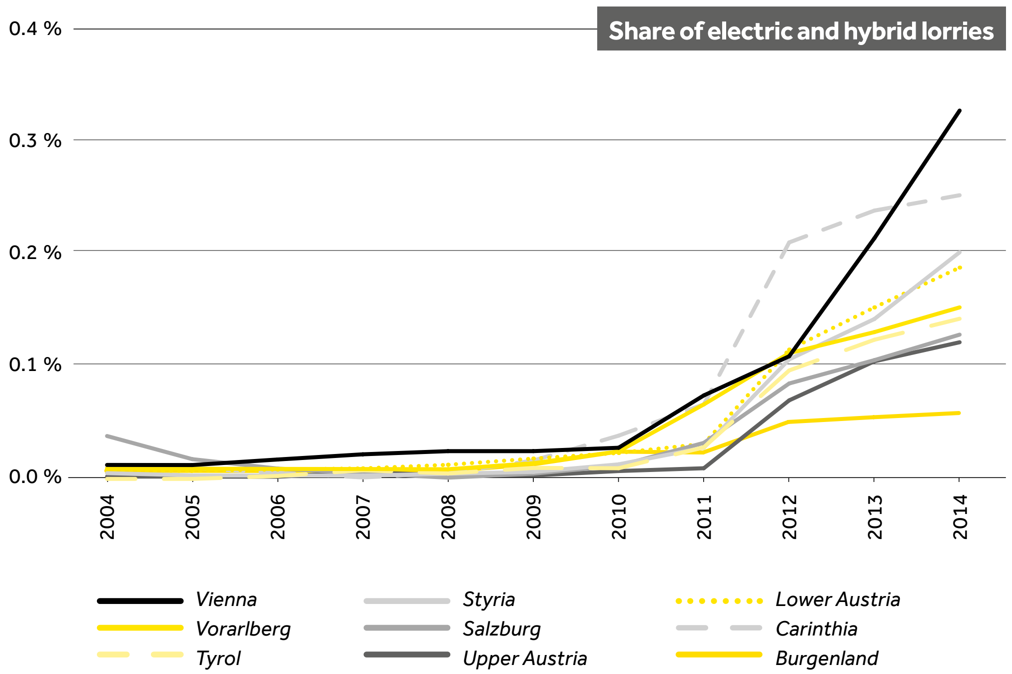


Fig. 1.7
Share of electric and hybrid lorries by federal province, 2004-2014
Source: [KFZ-Bestand]

Note:
Commercial traffic both originating and terminating in Vienna is currently not being measured. Not all commercial vehicles registered in Vienna are used for trips within Vienna. The target value cannot be exactly monitored with the currently available data.
Included vehicles: Lorries and semi-trailer towing vehicles (category N) as well as small motorised transport vehicles.

h. Energy consumption of passenger traffic across city limits

One of the energy-related objectives defined in the Smart City Wien Framework Strategy section "Resource-conserving mobility" is:
Reduction of energy consumption by passenger traffic across municipal boundaries by 10% by 2030.

Table 1.8
Fuel consumption of cars of non-residents in Vienna
Sources: [Private PKW, MA 18, SCWR]

Fuel consumption of cars of non-residents in Vienna	1991	2010	2015	Change [%] base year 2010
Distance driven by cars of non-residents in Vienna (in million km)	1,596	1,820	1,809	−0.6 %
Average fuel consumption in Vienna [l/100 km]	8.5	7.3	7.1	−2.7 %
Fuel consumption of cars of non-residents in Vienna [in million l]	136	133	128	−3.3 %

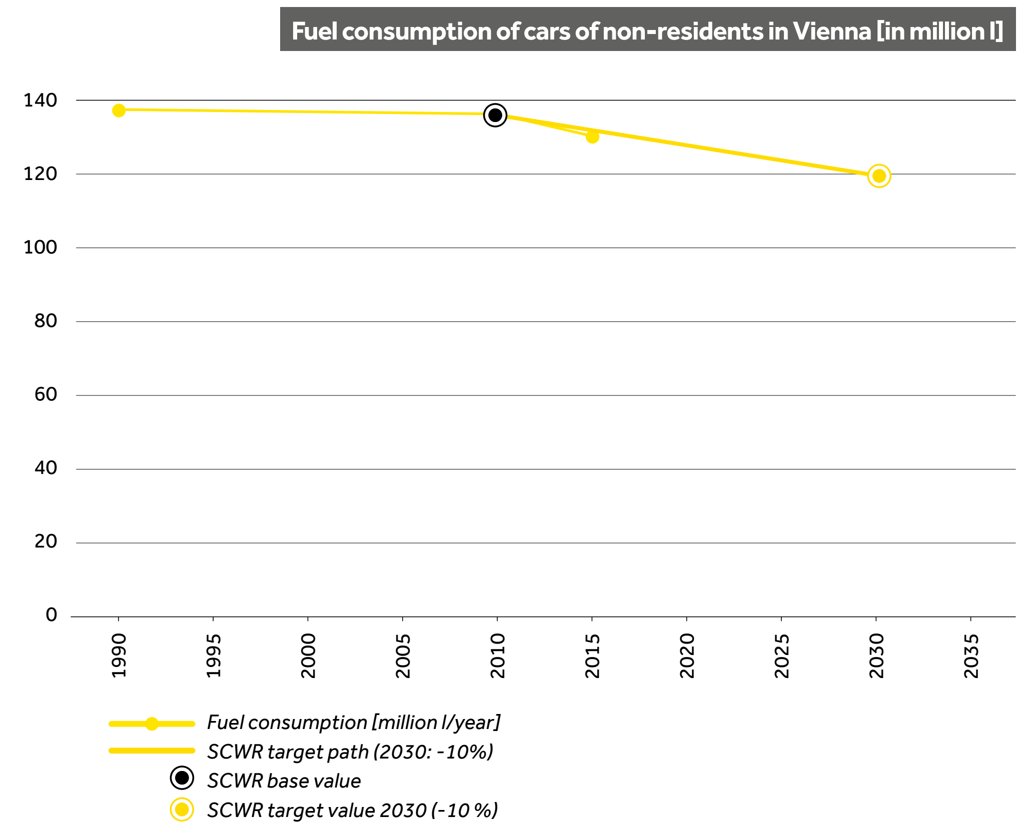


Fig. 1.8
Fuel consumption of cars of non-residents in Vienna, 1990, 2010 and 2015, SCWR target
Sources: [Private PKW, MA 18, SCWR]

Note:
The energy consumption of passenger traffic across city boundaries is not currently being measured.
Fuel consumption is calculated based on the average consumption of cars in Vienna (Statistics Austria) and the simulated driving performance of cars of non-residents in Vienna according to the traffic model (MA 18).
These results do not match the defined SCWR target (traffic of non-residents versus traffic across city limits).

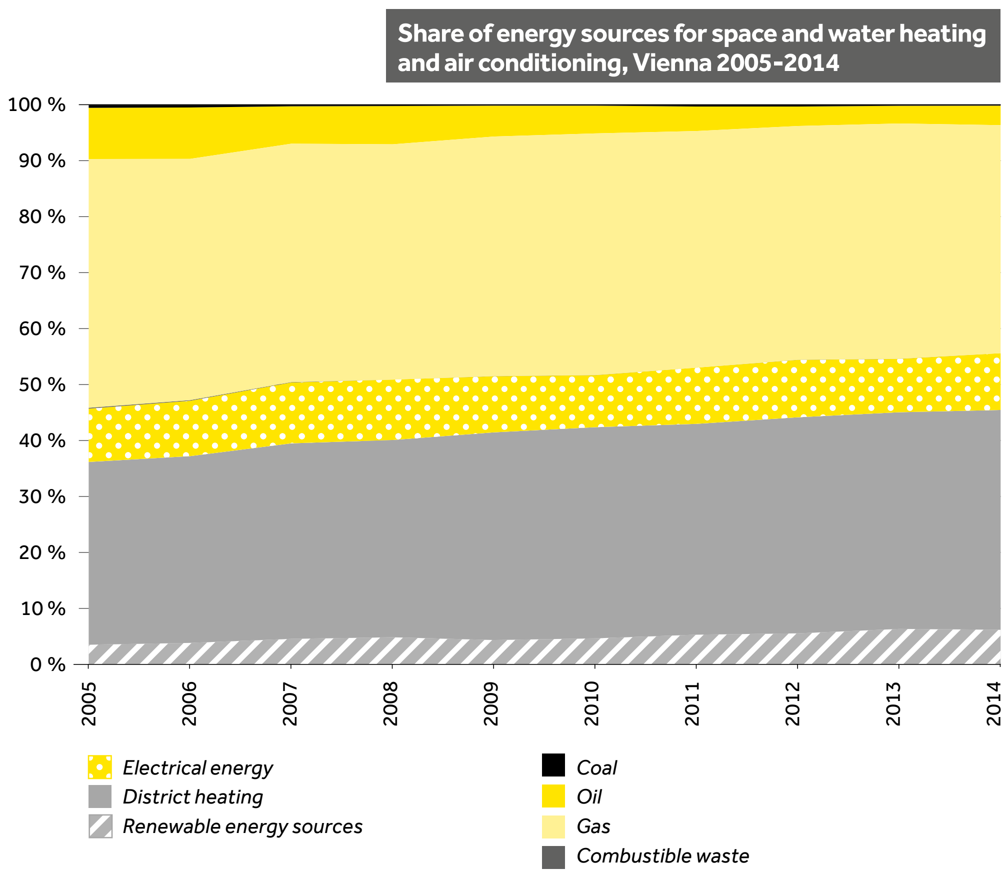
i. Share of energy sources for space and water heating and air conditioning

One of the energy-related objectives defined in the Smart City Wien Framework Strategy section "Buildings: Built environment and new structures" is:
Cost-optimised zero-energy building standards for all new structures, additions and refurbishment from 2018/2020 and further development of future supply systems towards even better climate protection levels.

Table 1.9
Share of energy sources in final energy consumption for space and water heating and air conditioning in Vienna
Source: [Nutzenergieanalyse 2014]

Share in final energy consumption	2005	2010	2013	2014	Change [%] base year 2005
Combustible waste	0.1 %	0.0 %	0.0 %	0.0 %	−91.6 %
Electrical energy	9.5 %	9.3 %	9.5 %	10.2 %	+6.6 %
District heating	32.7 %	37.8 %	38.8 %	39.3 %	+20.2 %
Gas	44.5 %	43.2 %	42.1 %	40.8 %	−8.4 %
Coal	0.5 %	0.1 %	0.1 %	0.1 %	−77.1 %
Oil	9.2 %	4.9 %	3.2 %	3.5 %	−62.0 %
Renewables total	3.5 %	4.6 %	6.3 %	6.1 %	+77.3 %

Fig. 1.9
Share of energy sources in final energy consumption for space and water heating and air conditioning in Vienna, 2005-2014
Source: [Nutzenergieanalyse 2014]



Note:
Renewable energy sources include biogenic fuels, fuel wood and ambient heat. The Vienna district heating system uses renewables, waste heat (e.g. cogeneration) and peak load power plants (e.g. gas).

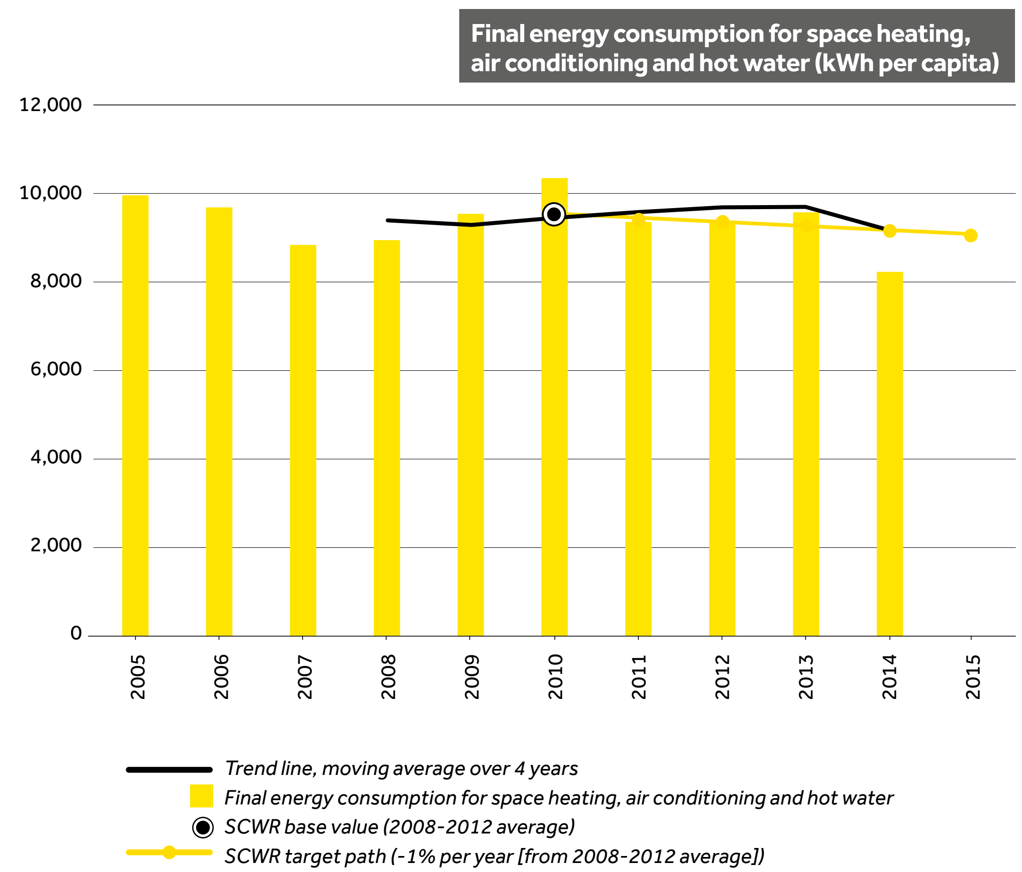
j. Final energy consumption for space and water heating and air conditioning per capita

One of the energy-related objectives defined in the Smart City Wien Framework Strategy section "Buildings: Built environment and new structures" is:
Comprehensive refurbishment activities entail the reduction of energy consumption of existing buildings for space heating/cooling/water heating by 1% per capita and year[3].

Table 1.10
Final energy consumption for space and water heating and air conditioning in Vienna per capita
Source: [Nutzenergieanalyse 2014]

kWh per capita	2005	2010	2013	2014	Change [%] base year 2010
Final energy consumption for space heating, air conditioning and hot water	10,014	10,405	9,628	8,277	−20 %

Fig. 1.10
Final energy consumption for space and water heating and air conditioning in Vienna per capita, 2005-2014, SCWR target path
Sources: [Nutzenergieanalyse 2014] and [SCWR]



Note:
The target path „-1% per year from 2010" is calculated using the equation
Target value $_{(\text{Target year})}$ = Final energy consumption $_{(\text{Base year})}$ × $0.99^{(\text{Target year-Base year})}$.
The starting year is 2010 and the starting value is the average of 2008 to 2012.

[3] This target value assumes that the federal government and the EU create suitable framework conditions to support the measures.

More information on Municipal Department 20:
www.energieplanung.wien.at