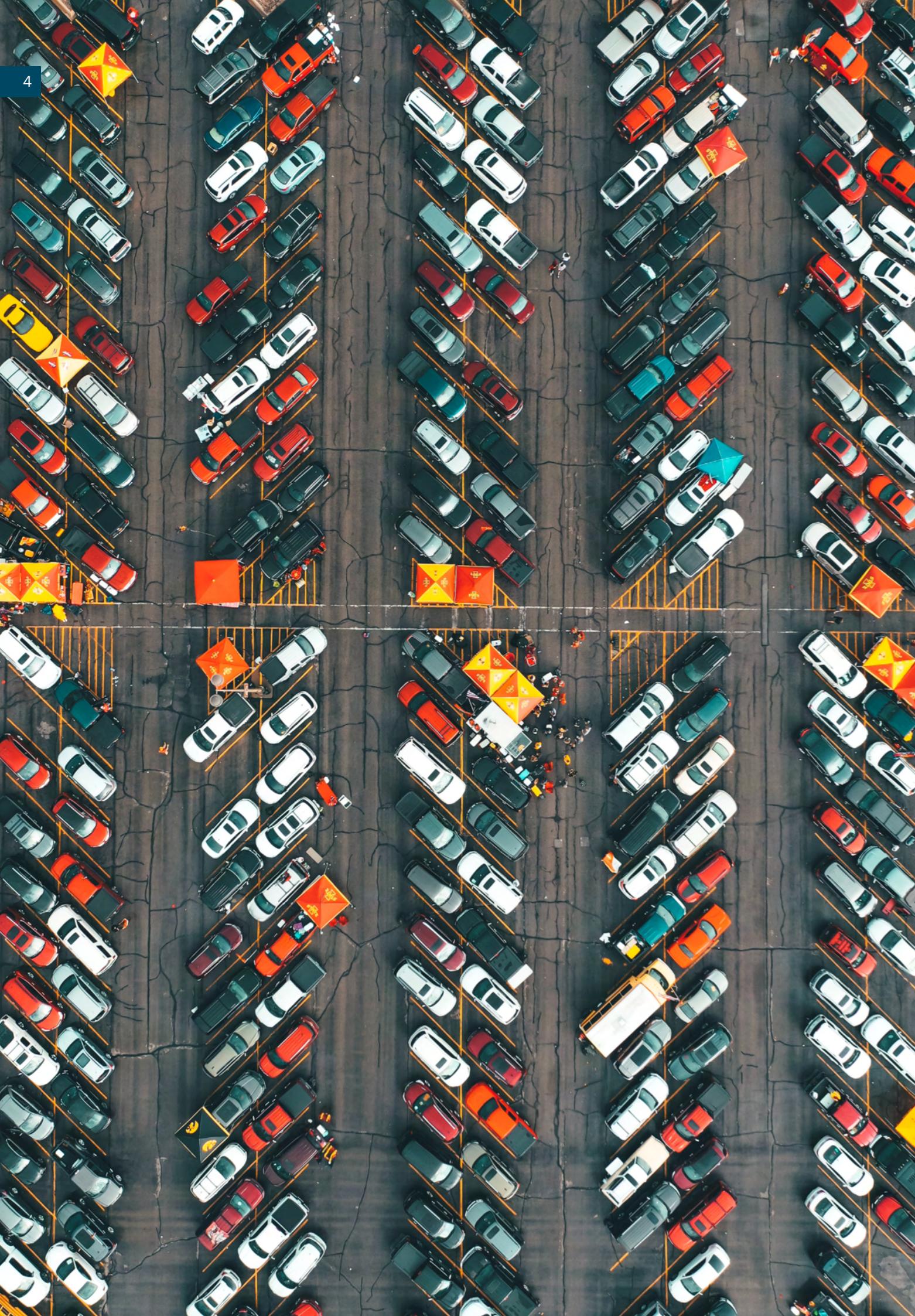


Garages and parking spaces - Development areas of tomorrow!

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INTRODUCTION

According to the Federal Environment Agency, 2,079 km² were sealed by traffic areas in Austria in 2020, which corresponds to more than five times the area of Vienna. (Federal Environment Agency, 2020). The disappearance of fertile soils, erosion, flooding and less biodiversity are just a few of the consequences of this development. Let's think ahead, when car sharing and autonomous vehicles are the future, when the need for cars is fundamentally reduced. A large vacancy rate in garages is already being reported. Likewise, electromobility and thus charging infrastructure options are increasingly coming into focus. Many of these developments also require intelligent and user-friendly digital solutions. Legal requirements make forward-looking changes difficult; in Vienna, for example, one parking space per 100 m² of living space is mandatory, but demand is often already lacking. In addition, every new parking space built stands in the way of climate protection. This is because parking space means that soil is sealed and individual transport is promoted instead of public transport. The first measures to counteract the sealing of valuable areas can be found in the EU taxonomy. But the regulation will not remain the only step in this direction. What must therefore not be missing is the flexibility in the subsequent use and conversion of garages, which must be taken into account now and already in the planning stage. Likewise innovative solutions are needed for the steadily growing concrete deserts.

This gave the ÖGNI the impetus to address the current situation as well as the future of garages and parking areas in a working group with experts from the sectors. Two small groups established the status quo, which

conversion as well as after-use concepts already exist and will also be needed in the future, as well as which challenges we will face in the process. In the new construction group, a checklist for the planning phase is also provided so that parking areas can be easily repurposed for a future in which there will be very little private transport. Likewise, the working group devoted itself to guidelines and laws and the fundamental differences between urban and rural areas.

Exciting discussions with the participants of the working group also resulted in demands to be able to successfully address the future issues already now. The objectives of the position paper before you are both to raise awareness among the actors as well as to point out possibilities of how implementation can succeed in practice and what is needed to achieve this. Examples in Austria, but also internationally, show how garages and parking areas can be designed to be fit for the future.

The position paper is aimed on the one hand at cities, states and municipalities, and on the other hand at all actors in the construction and real estate industry who are concerned with the future of garages and parking areas and who aim to actively address the associated challenges.

We wish you interesting reading!

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Gender Disclaimer

Exclusively for the purpose of better readability, gender-specific spelling is not used. All personal designations in this brochure are to be understood as gender neutral.

ABOUT ÖGNI

About ÖGNI

The ÖGNI -Austrian Sustainable Building Council- is an NGO (non-governmental organization) for the establishment of sustainability in the construction and real estate industry. The ÖGNI's work focuses on the certification of sustainable buildings Blue Buildings.

About the DGNB certificate?

The DGNB system of the ÖGNI serves to objectively describe and evaluate the sustainability of buildings and districts. The quality is evaluated, considering all aspects of sustainability, over the entire building life cycle. The DGNB certification system is internationally applicable. Due to its flexibility, it can be adapted precisely to different building uses and country-specific requirements. The DGNB system considers all essential aspects of sustainable buildings. These include the six subject areas of ecology, economy, socio-cultural and functional aspects, technology, processes, and location. The first four topics are equally weighted in the assessment. This makes the DGNB system the only system that gives equal weight to ecology and the other factors that make a decisive contribution to the creation of a sustainably successful building.



1. STATUS QUO

1.1 Background of the Topic

In 2020, Austria emitted 73.6 million tons of carbon dioxide equivalent. This corresponds to a reduction of 6.2% compared to the Kyoto year 1990 and a decrease of 7.7% compared to 2019, which is still far too high in terms of the targets which should have been achieved in 2020 (47.8 million tons) (See Figure 1)

The year 2020 was marked by the global Corona

other things, transport and mobility and thus also the future of garages and parking areas.

But it is not only transport emissions that pose a problem. Austria is the front-runner in Europe in terms of land consumption. Every day, areas the size of more than 12 football fields are used for development. (Pallinger, 2022)

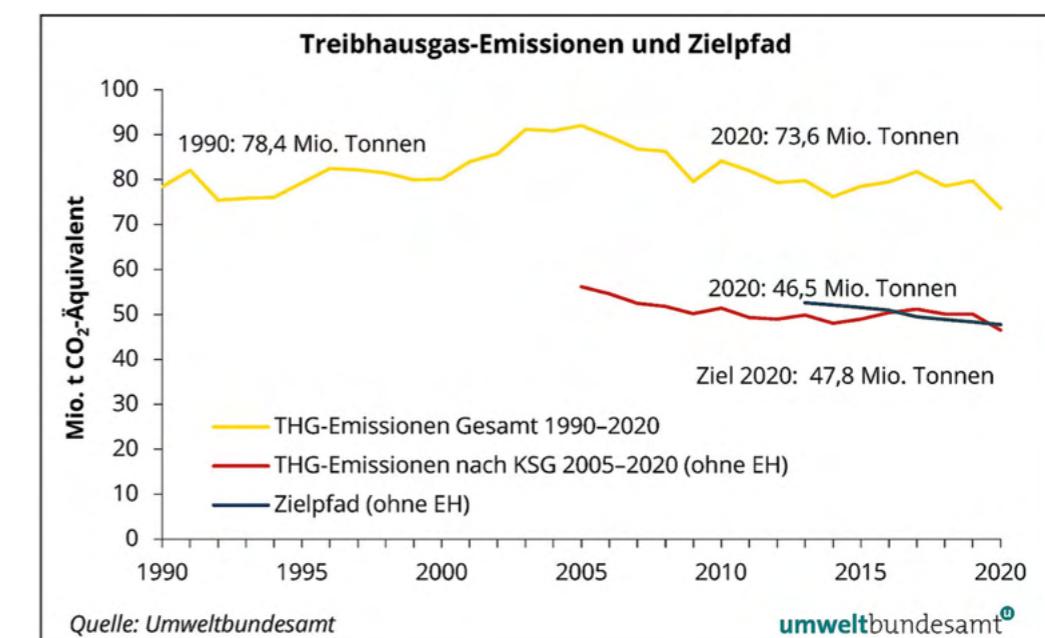


Fig 1: Umweltbundesamt GmbH (2020), greenhouse gas emissions and target path

pandemic with resulting epidemiological protective measures and profound effects on the economy and society. The strong decrease in emissions is thus mainly due to the Corona pandemic and the associated slump in (mainly passenger car) mileage as well as iron and steel production. The European Union has set itself the goal of climate neutrality (net zero greenhouse gas emissions) by 2050. Far-reaching transformation steps are required to achieve Austria's targeted climate neutrality in 2040. (Umweltbundesamt, 2020) These concern, among

Land consumption (total building area + transport area + leisure area + excavation area) amounted to 5,768 km² in Austria in 2020. Of this, 41% is sealed land. This results in numerous negative ecological and economic consequences: Loss of biological functions and productivity, endangerment of biodiversity, increased flood risk, loss of dust retention, heat effect. (Umweltbundesamt, 2020)

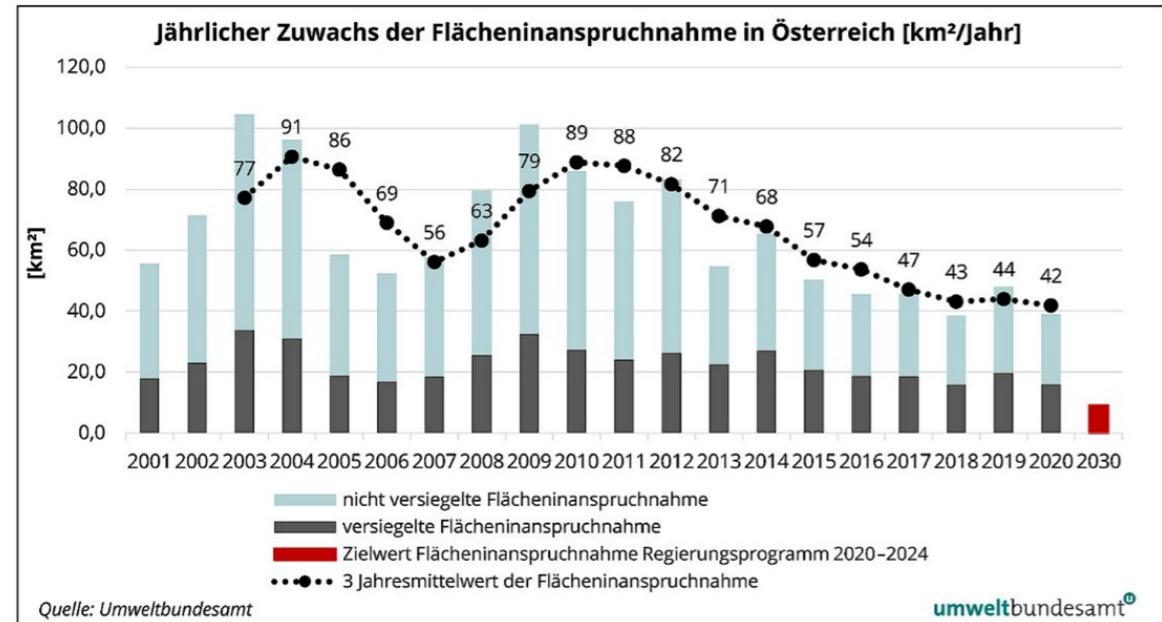


Fig. 2: Umweltbundesamt GmbH (2020), Annual increase in land use in Austria (km²/year)

light blue = unsealed land use, gray = sealed land use, red = target value for land use government program 2020-2024, black points = three-year average of land use

Climate protection in the Building Regulations for Vienna

The Viennese Building Regulations offer exemplary possibilities to make the city more climate-friendly. In addition to topics such as heating systems and energy efficiency, spatial planning instruments are also increasingly coming into focus.

The creation of conditions for the most economical and ecologically compatible use of natural resources as well as land was already provided for in the planning objectives before the most recent amendment of the building regulations. For the municipality of Vienna, the negotiating power for the implementation of sustainable projects was also expanded. In this context, measures such as the implementation of green spaces or certain urban development qualities, but also traffic concepts for the promotion of bicycle traffic, minimization of car traffic and the implementation of e-charging stations can be mentioned. Since the principle of proportionality applies to the municipality of Vienna, it is not possible to say how far these can go in imposing measures in individual cases, despite the high public interest in climate protection measures. One reason for this is, among others, that to date, as far as can be seen, no (at least publicly available) "guidelines" have been issued

to define performance obligations in the context of urban development contracts. (Gabriel, 2021)

E-mobility

The creation of charging spaces for electric mobility is legally stipulated in the Vienna Garages Act 2008 (WGarG 2008). In the course of the amendment LGBI 2020/61, provisions for the implementation of charging infrastructure for new construction projects were included, which are based on the requirements of Directive (EU) 2018/844. Accordingly, it was stipulated that for newly constructed non-residential buildings with more than ten parking spaces, at least one charging station must be installed for every tenth parking space and an empty conduit for the corresponding cabling must be installed for at least every fifth parking space (§ 6 para 3a WGarG 2008). In the case of new residential buildings with more than ten parking spaces, on the other hand, an empty conduit must be provided for each parking space (§ 6 para 3b WGarG 2008). Likewise, both provisions apply in the case of major renovations under the further conditions specified in the provisions. (Gabriel, 2021) But it is not only the Vienna Garage Act 2008 that provides for this creation of charging spaces. In the Lower Austrian Building Code 2014 (also NÖ

BO 2014), for example, under §64 NÖ BO 2014, there are also requirements to at least provide the cable infrastructure for the subsequent installation of charging points for electric vehicles.

Excursus EU Taxonomy Regulation

The EU Taxonomy Regulation VO (EU) 2020/852 also addresses the issues of transport emissions and soil consumption already mentioned.

Chapter 6 "Transport" addresses, among other things, local and regional passenger transport and road passenger transport. In order to create a sustainable financial flow in the sense of the EU Taxonomy Regulation, no direct CO₂-emissions may be caused by the activity of passenger transport. (Annex I, Supplement to the EU-Regulation, 2020)

The consumption of valuable land is also dealt with in the regulation. The currently available 'Do No Significant Harm' criterion "Protection and restoration of biodiversity and ecosystems" specifies the areas on which construction is no longer allowed in the EU area since the regulation comes into force (2021), if one wants to generate a sustainable capital flow in the sense of the EU taxonomy. No distinction is made here as to whether parking areas, buildings or other structures are constructed. The decisive factor is the quality of the soil and the biodiversity contained in and on it.

Vacancy rate

Unfortunately, no representative vacancy figures are available for garages and parking spaces in Austria. The individual garage operators do have surveys for their own managed garages, but these are not publicly available and also not representative. In Neubau, the 7th district of Vienna, a survey of the utilization of all parking spaces was conducted on behalf of the district and the MA 28 - Road Administration and Road Construction. Not only parking spaces in public areas or in public garages were taken into account, but also parking spaces in residential garages. The vacancy in garages shown in the parking space balance would provide space for all vehicles registered in the district, but these are often parked in public areas. (komobile w7 GmbH, 2019) Surveys in other districts have not yet taken place. This fact makes it clear that the problem of vacant parking spaces has not reached the general

public. This circumstance is not yet seen as a problem, especially since a garage that is only empty at night, for example, is not even considered a "vacancy". However, we are all familiar with the pictures of large parking areas around shopping centers, supermarket chains and the like, which are only allowed to be occupied during opening hours and, seen over their entire lifetime, therefore have a lot of vacant periods. This leads to the next point.

Status of parking area

As already mentioned, not only traffic emissions are a problem for our environment, but also the use of land for car parks, underground and multi-story garages or other parking and feeder areas. What is the problem when land is "consumed"? The WWF Land Report 2021 states: "Land consumption poses a massive threat to Austria's diversity of habitats and species. In addition to habitat loss through construction, fragmentation by roads and other infrastructure is also a driver, as it prevents the dispersal of animals and plants. Deteriorated habitat conditions can lead to the migration or even disappearance of species." (WWF, 2021)

This is countered by the obligation to provide parking spaces, which is laid down in the building regulations or further-reaching laws of the States. As an example: In the Lower Austrian Building Code 2014, § 11 stipulates the minimum number of parking spaces. Thus, in residential buildings, 1 parking space must be provided for every flat, in restaurants for every 10 seats or, for example, in commercial enterprises with a sales area of more than 750 m², for every 30 m² of sales area. The guideline number of parking spaces for bicycles to be provided according to § 65 para 1 Lower Austrian Building Code 2014 is as follows: 1 bicycle parking space for every 1 dwelling in residential buildings, 20 seats in restaurants or approximately per 50 m² sales area in commercial buildings - irrespective of the total size of the business. However, it is stated in the Lower Austrian Building Code 2014 under § 63 that the required number of parking spaces for motor vehicles may be increased by the municipal council in a separate ordinance if the local need prevails. It is not possible, however, as shown in this example, to adjust the parking spaces to the real demand or to omit them altogether. If it is demonstrably not

possible to build on one's own land, a parking space compensation levy must be paid to the municipality in Lower Austria.

But there is another way. In Berlin, the parking space requirements were already abandoned in the 1990s, Hamburg followed in 2013 ("Lebendige Stadt" Foundation, 2021).

Trends and visions

The ÖGNI is not the only organization to address the topic of future mobility and its effects - in this case, specifically with regard to parking spaces for motor vehicles. In a project, students at the University of St. Gallen looked at garage visions up to 2025 and

The role and use of garages are therefore undergoing a major change. Progressive urbanization and thus the growth of urban living spaces is leading to increasing demand for parking space, especially in peripheral regions. At the same time, many municipalities are taking a turn towards a reduction in motorized private transport. The measures we see in Europe to achieve this vary. Here, for example, we should refer to the EU project "Push & Pull" from 2015, which deals with intelligent, quality-promoting parking space management. (Push & Pull, 2015)

Another factor that will give additional importance to garage operations in the future is the increasing electrification of vehicle fleets. Recently, the European

of the City of Vienna, MA 18, 2020) In response to the commuter movement, short-stay parking zones were introduced throughout the entire Vienna city area on 1 March 2022 in all 23 Vienna municipal districts, and the districts of Simmering, Hietzing, Floridsdorf, Donaustadt and Liesing were added. Thus, a uniform parking space management system in the form of a parking sticker now applies to every district. Vehicle owners can purchase a parking sticker for the district in which they are registered (a Viennese license plate is required). Outside their own district, owners of parking permits as well as all other vehicle owners without a parking permit must purchase parking tickets by the hour in order to park their vehicles in public spaces. The background and goal of this political measure is to provide more free parking spaces for the Viennese, to reduce the traffic volume (among other things, the so-called parking space search traffic decreases) in the densely built-up areas of the city as well as to advance climate protection and to improve the quality of life of the population through new possible uses of the parking spaces. (City of Vienna, 2021)

Due to the changed legal framework and the resulting further increase in the shortage of short-stay parking spaces - especially for commuters - there are a number of challenges, but also opportunities to react to these developments.

With the expansion of short term parking zones to the entire city of Vienna, there has been a shift of parked vehicles from the street to existing garages in Vienna, as commuting non-Viennese can now no longer park in short term parking zones. Although there are now significantly more short-stay parking spaces available at the side of the road in the outer districts, the existing Viennese parking garages, on the other hand, are overused, so that people looking for a parking space can hardly find a space for their vehicle at certain times. This is also due to the fact that in the course of the introduction of the citywide parking sticker, the City of Vienna made hardly any efforts to create additional parking infrastructure at the city limits or other important traffic junctions within the city.

According to an article in Der Standard, it was already stated at the beginning of March that the number of short-term parkers at individual park-and-ride locations has increased by up to 25% since the start

of the Parkpickerl on 1 March 2022. Thousands of on-street parking spaces, on the other hand, have remained vacant. Commuters in particular were forced to change their routines, which is why the demand for parking spaces and garage spaces increased sharply, especially on the outskirts of the city. (Krutzler, 2022) An increased expansion of public transport connections as well as well thought-out sharing concepts would be desirable. Whether the aforementioned increase in utilization in garages will continue in the long term cannot be said at present. In view of the trends mentioned, however, it is hardly conceivable.

Example Berlin - Lifting of the parking space requirements

The city of Berlin can be taken as an example of a forward-looking change. In Berlin's parking space statute, mandatory parking spaces are no longer required. The exception is a small number for people with severe walking disabilities or wheelchair users. Otherwise, mandatory parking spaces are only to be created for bicycles. This has advantages, but also disadvantages. On the one hand, the reduced creation of parking spaces also induces less car ownership and car traffic, which can save costs in the housing sector. On the other hand, the requirement could in some places lead to congestion in public parking areas and the city lacks the leverage to create alternatives in exchange for compulsory parking spaces. Thus, project developers are largely exempt from having to contribute to the mobility costs of future users.

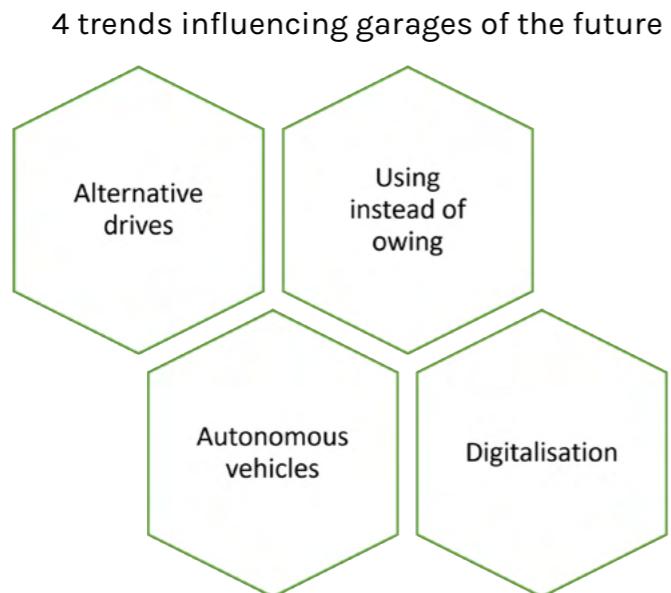


Fig. 3: Based on Garage Vision 2025, A project of the University of St. Gallen

identified four trends that car garages are subject to. It is clearly recognizable that these are closely related to the future of mobility: Alternative drives, using instead of owning, autonomous vehicles and digitization. This will create new competence requirements for garage operators and demand new concepts. (University of St. Gallen, n.d.) This means that in the future, hopefully not only will less parking be needed, but that the parking that will continue to be needed will have to be designed differently, as the way in which individual traffic functions as well as the general conditions change.

Union decided to ban the registration of new vehicles with combustion engines from 2035. Established and new manufacturers are already entering the market with electric vehicles, even if availability is currently still low and delivery times are long.

In addition, urban land is gaining in value and this limited commodity must be handled carefully. In Vienna, for example, in 2020 the share of non-Viennese license plates outside the area-wide parking management system in the 11th district was 18% on average, and around 40% at peak times. (Magistrate

1.2 Guidelines & Laws

When thinking about the future of garages and parking spaces, in addition to the influencing factors already mentioned, there is also the large topic of guidelines and laws. This is not an insignificant factor - after all, it defines the scope and limits of what is currently possible.

Building Regulations for Vienna and Vienna Garage Act 2008

In Austria, nine different building regulations are in force, which do not contain uniform regulations on parking spaces for Austria.

In Vienna, the legal basis for the parking space requirements is the Vienna Garage Act 2008, which defines that a parking space requirement arises in the case of new buildings and additions as well as changes in zoning or room division (§ 48 para 1 WGarG 2008). The obligation to provide a parking space can either take the form of a

- » payment in kind (required parking space) or
- » the contractual securing of a parking space outside the building site within a radius of approx. 500 meters or
- » by paying a compensation fee. (However, the construction regulations enforcement office requires detailed evidence that required parking spaces or securing parking spaces in the vicinity are not feasible before compensatory levies are allowed).

Currently in Vienna, the creation of one parking space per 100 m² of usable living space is stipulated in new residential construction.

For spatially limited parts of the urban area, the development plan can stipulate special regulations on the permissible extent of the creation of parking spaces and reduce the extent of the parking space requirements by up to 90% (parking space regulation according to § 5 para 4 lit b Building Regulations for

Vienna). The development plan may also contain an order on the manner in which the parking space requirements are to be fulfilled and the permissibility and extent of garage buildings as well as outdoor parking spaces.

A reduction of the parking space requirements (§ 48 WGarG 2008) is only permissible if the municipal council specifies the parking space reduction in the zoning and development plan (e.g. due to new buildings and extensions in the context of particularly good accessibility by public transport). (Vienna Chamber of Commerce, 2021)

Spatial planning contracts

As a supplement to sovereign spatial planning, all state spatial planning laws now provide for the possibility of concluding spatial planning contracts under private law. However, the scope of the respective agreements and their practical application vary greatly from one federal state to the next. (Madner/Mayr/Grob, 2020)

In Vienna, the possibility to conclude spatial planning contracts under private law, the so-called urban planning contracts, was introduced with the amendment LGBI 2014/25 coming into force on 16 July 2014. The conclusion of urban development contracts is intended to achieve the following planning objectives in particular:

- » Supporting the realization of the 17 planning objectives pursuant to § 1 para 2 Vienna Building Code;
- » the provision of sufficient areas for necessary housing, workplaces and production sites; as well as
- » the participation of landowners in the costs of infrastructure. (§ 1a Vienna Building Code)

With the help of an urban development contract, measures such as traffic concepts for the promotion of bicycle traffic, minimization of car traffic and the implementation of e-charging stations can be agreed

upon (Gabriel, 2021), but a reduction of required parking spaces cannot be subsumed under this.

Parking spaces in condominium ownership

While buildings in sole or joint ownership can be used as the respective owners see fit - subject to compliance with the respective legal standards - this is more complicated in the case of buildings involving condominium ownership.

By granting condominium ownership, the respective co-owner of a property acquires the right in rem to exclusively use the condominium property assigned to them. (§ 2 para 1 Condominium Act 2002, known as WEG 2002) This possibility of use is limited, among other things, by the respective dedication of the condominium property in the condominium contract. Aside from apartments, condominium property can also be other independent premises, such as storage rooms, or even parking spaces for motor vehicles. (§ 2 para 2 WEG 2002) By establishing condominium ownership, an exclusive right of use can thus also be acquired to a floor area under certain conditions.

While an apartment can be dedicated either as a residential space or as a commercial space, but also as a mixed-use space (Hausmann in Hausmann/Vonkilch, comment Austrian Housing Law - WEG4 (2017) § 2 WEG Rz 8a), a parking space for a motor vehicle is a clearly demarcated floor area - e.g. by a floor marking - which is exclusively dedicated to the parking of a motor vehicle and is suitable for this purpose in terms of its size, location and configuration. (§ 2 para 2 sentence 4 WEG 2002)

If the condominium owner wishes to change the dedication of his condominium property, the requirements of § 16 para 2 WEG 2002 for the change must be complied with, otherwise an arbitrary and thus unlawful change of dedication exists. A change of dedication is, generally speaking, any deviation from the type of use specified in the condominium contract, so that the concept of a change of dedication is to be interpreted broadly in principle. (Verweijen, 2003) The dedication specified in the ownership contract can only be changed afterwards by the (implied) consent or the (implied) waiver of all co-owners or by the court according to § 52 para 1 no 2 WEG 2002. (Hausmann in Hausmann/Vonkilch, comment Austrian Housing Law - WEG4 (2017) § 2 WEG Rz 8.)

However, a change of dedication of parking spaces is usually ruled out, because this would also remove the suitability of the parking space as a condominium property. (Prader, WEG5.12 § 2 (as of 13.10.2021, Manz Wohnrecht) In order to maintain the suitability of parking spaces for condominium ownership even in the event of a structural and legal change of dedication to e.g. storage rooms or similar, an alternative use of floor areas as condominium property would already have to be permissible under the WEG 2002. In addition, the condominium ownership contract (or another agreement between the co-owners) would have to expressly provide for an alternative use. If the parking spaces are not in condominium ownership but are common area, an alternative use of the parking spaces would be easier if, for example, the space is rented to a third party. This could be decided by the property management as representative of the owners' association within the scope of ordinary property management with the income also going to the owners' association. (OGH RS0013564) Renting to co-owners and condominium owners, on the other hand, is a matter of extraordinary administration, which is why the conclusion and termination of rental agreements requires the consent of all condominium owners. (OGH 25.11.1997, 5 Ob 2330/96z) In practical everyday life, an impossibility.

1.3 Differences between urban and rural areas

It is obvious that mobility concepts and the associated parking management must be considered in a differentiated manner due to the structural differences between urban and rural areas. The different mobility behavior of the population can be seen in Figure 4 (statistics from 2013/14). It is shown that the more urban one lives, the more often public transport is used. In Vienna, this was the case for around 38% of Austrians in the period surveyed, and only 8% in the peripheral districts. Due to the shorter distances in the city, the share of journeys made on foot also increases there to 25%. In the peripheral districts, the share is 15%. (Climate Alliance Austria, 2013/14)

Figure 5 also shows the modal split from 2019 to 2021 in Vienna and thus the mobility behavior of Viennese in the last three years. In 2020, walking experienced an upswing - also due to the Corona crisis. 37% of all trips were made on foot. This exceptionally high level was almost maintained in the following year: 35% - i.e. more than a third - of all their trips were made on foot by the Viennese in 2021. Likewise, the share of journeys made by bicycle increased in 2020. The public transport share recovered slowly again compared to 2019, rising from 27 to 30%. Previously, public transport experienced very strong declines in the modal split due to the Corona pandemic. Ultimately, the key question for the climate targets of the City of Vienna is whether there will be a change in the share of car use in the Viennese's choice of transport mode. Surprisingly, this was not the case in 2020. The second pandemic year showed a slight decrease of one percentage point. This is remarkable: since 2012, the share of car travel in the modal split has been fairly constant at 27%. Only after 9 years and an extreme event like the Covid-19 pandemic does this seem to have changed.

It remains to be seen whether measures such as parking management, awareness raising and

the development of good cycling and walking infrastructure can continue this trend. (Jens, 2022)

What are the special qualities of rural areas?

As has been shown, there is a larger share of private motorized transport in rural areas. This is due, among other things, to the spatial structures and the reduced availability of public transport. Accessibility is also a decisive criterion for the quality of a transport system and ensures social participation for the inhabitants. "Accessibility" is understood as the possibility to get to destinations, with a certain effort

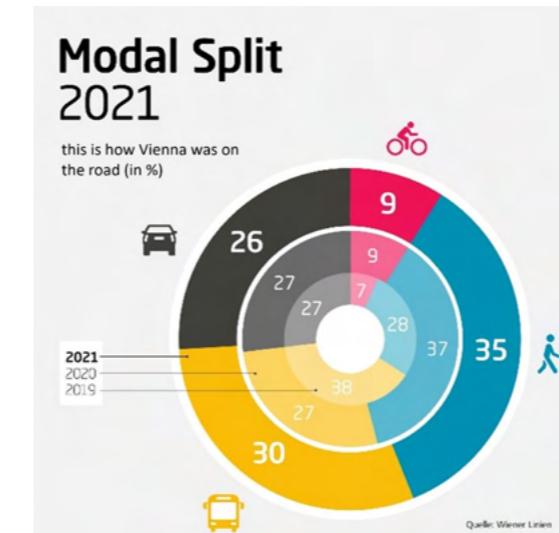


Fig. 5: Wiener Linien (2021), Modal Split 2021

(degree of accessibility) and also to stop/park there. Since in rural areas this is usually only possible with motorized private transport, parking spaces (car parks) should be designed in such a way that they can

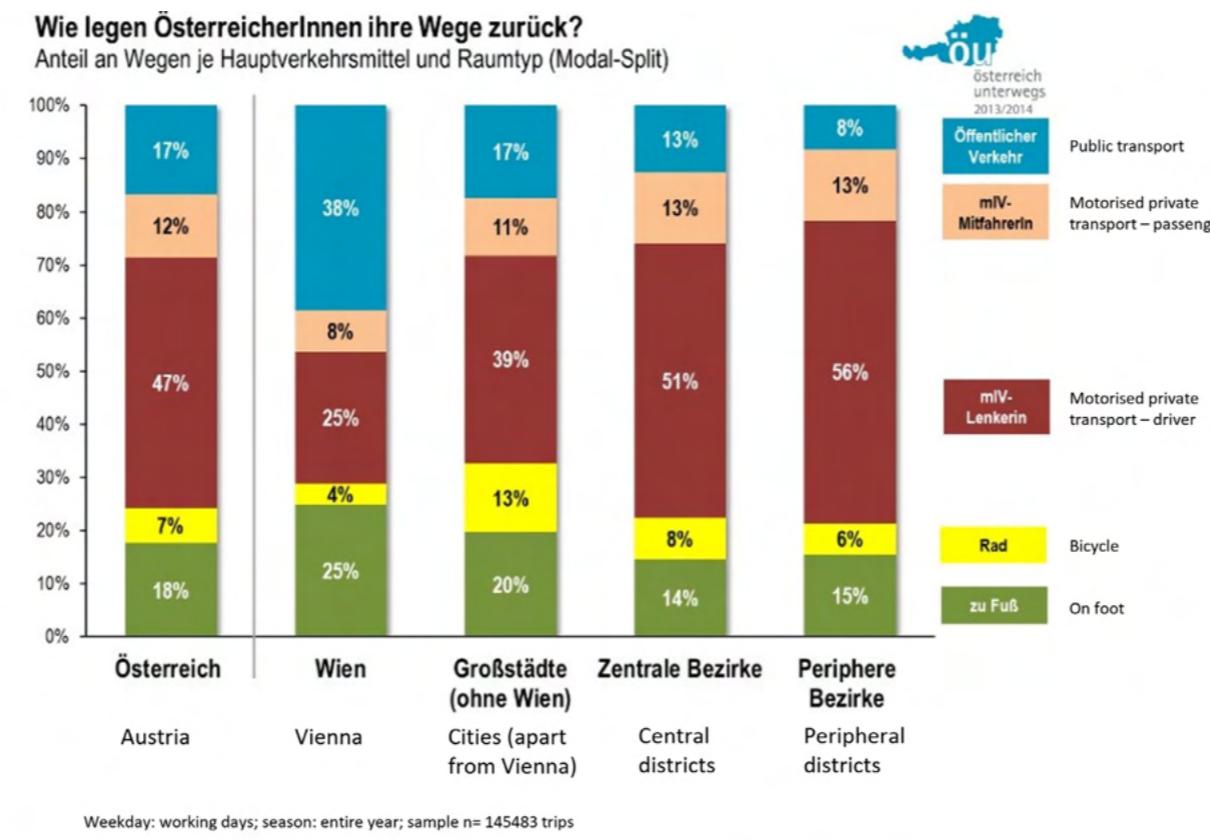


Fig. 4: Klimabündnis Österreich GmbH (2013/14): Modes of transports in Austria - modal split by regional type

be used differently at different times of the day and are attractive, on the one hand, and allow different uses, on the other hand. Shopping and deliveries are necessary during the day, and the focus here is on short distances and a short parking time, but the situation is different in the evening. In the evening, the space needed for the day can become a recreational area and should not have to continue to be used as a parking space. Uses as pub gardens/event venues, but also meeting places without the obligation to consume are conceivable. In this way, the sealed area, which has a high degree of vacancy in the evenings and at night, can be used twice and no additional space has to be developed.

In the town centers of rural areas, parking spaces could make sense in combination with meeting zones. An attractive street space can serve goods delivery, short shopping and social exchange during the day. In the evening, mobility quarters slightly outside the town center (in the countryside the distances are not so long) would take over the function of accessibility and social exchange in a widened and hopefully also traffic-calmed town center. Mobility quarters of the evening could be already existing parking spaces of the trade/commerce, which are otherwise exclusively used during the day.

With regard to shared street zones, it should be pointed out that in these areas all participants must have equal rights and that the speed of all participants should be oriented towards the slowest - the pedestrian. A shared street zone is not a street where the speed is reduced to 30 km/h, but a spatial structure in which cars can also drive and possibly park, but where there is also space for cyclists, pedestrians and plants.



2. EXISTING BUILDINGS

2.1 Status quo

In Austria, the number of parking spaces to be built is stipulated by the respective building regulations of the federal states. In Vienna, as described in chapter 1.1, the Vienna Garage Act 2008 forms the basis of the parking space requirements. As long as parking spaces are required by law, they will be built. In 2019, an article by ORF stated that many spaces are already empty in Vienna's parking garages. The vacancy rate is said to be up to 30%. (ORF.at, 2019)

However, as already mentioned in the chapter "Trends and Visions", according to an article in Der Standard, due to the comprehensive short-stay parking zone in Vienna as of March 2022, the occupancy rate in garages increased, especially in those on the outskirts of the city and with good public transport connections. (Krutzler, 2022) No valid figures can however be found for this at present.

Especially in Vienna, the cost-benefit ratio is the reason for younger generations to decide against owning a car, as there is a well-developed network of public transport in the city and an attractively

priced annual ticket is offered. Due to additional future developments, some of which were mentioned in the section "Trends and Visions", concepts for, at least partial, conversions should already be planned today and, among other things, the network of public transport for commuters and well-functioning sharing concepts should be expanded.

The working group also dealt with the issue of parking spaces, which are mainly built in the course of large retail chains or shopping centers. These also have potential for further uses (keyword flea market) due to the fact that there is usually no continuous use. Due to the scope of the working group, non-structural concepts to counteract such heat islands were not discussed. Nevertheless, successful structural examples can be found of how to deal with existing parking areas that are no longer in use.

The following sections describe the challenges posed by such conversion and after-use concepts and the solutions that have already been implemented.

2.2 Conversion and re-use concepts

Due to the reasons mentioned in the following chapter, the industry is currently not very concerned with concepts for the complete or partial re-use of parking facilities. Here, the cost of conversion competes with the alternative costs of demolition and a possibly simpler new construction afterwards.

For a subsequent use as residential or office space, the room heights and installations are the main obstacles. In addition, it should be kept in mind that not every conversion and reuse concept makes sense or is needed everywhere.

Nevertheless, some examples of conversion and after-use concepts, some planned and some already successfully implemented, are presented below. The research shows that the topic is very present, especially in Germany.



Fig.6: Magnus 31 © Wilkin & Hanrath Bauphasen



Fig. 7: Magnus 31 © Wilkin & Hanrath Bauphasen

1. Construction of apartments/offices/educational buildings etc. (car park superstructure, conversion/partial demolition of multi-story garages).

Demolition of parking levels- Contipark in Cologne - "Magnus 31"

Contipark has shown what conversion can look like on a large scale with the unprecedented project "Magnus 31". At the beginning of the nineties Contipark took over the Cologne multi-story car park "Alte Wallgasse". Due to the changing mobility behavior, the 450 parking spaces in the over 50 year old building were no longer fully used. Therefore Contipark, in cooperation with the city of Cologne, decided on a partial conversion of the building.

After demolishing several parking levels, 31 apartments ranging in size from 70 to 200 square meters were

built on the roof of the car park around a landscaped inner courtyard. The car park itself was extensively renovated. The result is valuable living space in a central inner city location, but also a modern and well-utilized multi-story car park. "Magnus 31" thus exemplifies how all parties involved can benefit from a well thought-out conversion.

The Friesenplatz multi-story car park is attractively located at a central Cologne transport hub. (Contipark, 2017)



Fig. 8: Magnus 31 © Wilkin & Hanrath Bauphasen

Gröniger Hof in Hamburg

In the middle of Hamburg's old town, the Gröniger Hof cooperative is planning a mixed-use residential building. An aging parking garage complex is to be converted for this purpose: Living instead of parking, green spaces instead of grey, in a cooperative organization and with a socially acceptable award policy. Duplex Architekten from Zurich won the realization competition in summer 2021. (Baunetz, 2021) Where cars used to park, lively living, working and a diverse coexistence are to take place in the future. A stacked urban landscape surrounded by lots of greenery - all under one roof in the middle of Hamburg's city center. Thus the conversion of the multi-story car park is much more than just the conversion of an existing structure, but above all a contemporary expression of social and ecological change. The typology of traditional Hamburg office

buildings with their narrow inner courtyards is taken up and paired with the idea of a living green space that develops from the building's interior as a carefully designed roof and terrace landscape. The open ground floor integrates the public street space, welcoming visitors and residents alike. "The crowning glory" of Gröniger Hof is the generous roofscape with further communal uses such as laundry, sauna and fitness room, the roof garden with playground and flower beds. (Duplex Architekten AG, 2021)

Redensification through car park development

A consistently sustainable approach to existing parking spaces is their redensification. In this way, already sealed areas are used twice, on the one hand as parking space as before, and on the other hand as living or working space.

Since buildable surface potential is known to be limited and the goal must be to keep additional surface sealing as minimal as possible, a promising and sustainable solution is redensification. Not only existing buildings are suitable for redensification, but also existing sealed parking areas in front of supermarkets, furniture stores and DIY stores. Since parking spaces are even usually perceived as a grievance in urban development, using the airspace above these parking spaces with affordable housing would be a welcome concept to protect the environment and, in combination with existing green concepts such as sustainable facades, to defuse the already existing heat spots and make them exemplary puzzle pieces of a society. Thus, car parks could make an important contribution to solving socio-economic and ecological problems. They create affordable housing, become part of a sustainable energy supply and reduce the overheating of populated areas. Another advantage of this redensification would be the already existing infrastructure. Thus, offers such as car sharing, e-charging stations and bicycle parking spaces could be more easily realized here.

Dantebad car park superstructure in Munich

A Munich project serves as a successful example of redensification with modular construction. Housing is particularly scarce and expensive in Munich, which is why the city council decided on the "Housing for All" housing development program in March 2016. The first project was realized by Florian Nagler Architekten for GEWOFAG: 100 small apartments for refugees and homeless people. The design for the 4,2000 m² site in Homerstraße was a four-story wooden hybrid building, almost 110 meters long and around 12 meters deep, with a south-facing arcade entrance. What is special about it is that the building was elevated, above an existing car park, which can still be used due to the construction. The architects succeeded in preserving 107 of the 111 parking spaces by arranging them at an angle. The arrangement of the parking spaces dictates the building grid. Additional meeting opportunities outside the apartments are provided by the communal spaces, such as a "laundry café" and an accessible roof. (Bauwelt, 2017)



Fig. 9: Dantebad © Stefan Müller-Naumann

Car park superstructure in Regensburg

The Bayerische Staatsforsten, as the client, has built a residential building in timber construction in Tillystraße in Regensburg. The 4-story building was erected on the former parking lot in framework construction with structural beech and solid timber walls. A total of 33 new apartments with a combined living space of over 900 square meters have been created.

The former parking spaces are available in the underground garage. Residents, on the other hand, can park directly under the elevated building in the ground floor area. The development and inner-city redensification of the former car park creates urgently needed living space without, however, using and sealing new areas. The green roof serves as a meeting place and recreation area for all residents.

The building, which stands on stilts, was clad with carbonized wood formwork made of local spruce. The carbonization technique, originally from Japan, results in a long-lasting wooden facade with very low maintenance costs. (Informationsverein Holz, 2021)



Fig. 10: Wohnhaus © Bayerische Staatsforsten

2. Storage rooms, also possible as stationary trailers (see example APCOA in chapter "New construction").

3. Take facades into account - climbing possibilities or climbing walls (multi-story garage)

4. Cultural conversion (galleries, installations, theatre, etc.)

Meeting place car park

The temporary use of derelict parking spaces is a promising way to revitalize vacant urban spaces. In the course of the Concéntrico Festival, temporary installations are set up annually at various locations in the Spanish city of Logrono to explore precisely this potential and to demonstrate possibilities. As part of last year's event, the Czech architecture firm KOGAA played with their "Circo Aéreo" in an unused car park area and gave the square a new vitality. The architects positioned white air cushions on a wooden construction. The circular arrangement of the four-meter-high construction created a space inside that functioned as a lounge and also as a place for events.

It was possible to enter the interior of the installation at three points. The passage height was about 1.50 m, so that one had to truly immerse oneself in the newly created space. During the day, the installation served as a source of shade, then in the evening as a source of light and a screen. This created an attractive communication space and meeting place with a high quality of stay. Seating integrated into the wooden construction also invited people to linger. (architektur Fachmagazin, 2021)



Fig. 11: Circo Aéreo © Kubicek Fotos



Fig. 12: Circo Aéreo © Kubicek Fotos



Fig. 13: Circo Aéreo © Kubicek Fotos

5. Roof gardens

One example is a neighborhood garden on top of the WIPARK garage in Windmühlgasse in Vienna's 7th district. With its 2,000m², it is very likely one of the largest in Europe. What makes it special is that it is a collectively managed community garden, which is cultivated 12 months a year by committed district residents. (Stadt Wien, 2019)

6. Social use of the roof or some floors of multi-story garages (children's playgrounds, sports facilities, flea markets, bars, etc.)

7. Flea markets - car park use also on Sundays (e.g. at department stores, supermarkets, etc.)

As an example, a Viennese project can be mentioned, namely the giant flea market Wienerberg in the 10th district of Vienna, which takes place every Sunday at the car park of a supermarket chain.

8. Logistics / delivery center (underground car parks)

Underground garages could serve as a receiving point for parcels, be it for private or business customers. The challenge here, however, would be the room height, which usually makes access for delivery vehicles (box vans) impossible. However, since the last mile is often more difficult to manage in urban areas, delivery bicycles could also be used, among other things, and would be a sensible concept, especially for smaller parcels.

9. Data centers (underground car parks)

10. After-hours hospitality - clubs / discos / bars (underground car parks)

11. Urban farming, e.g. cultivation of edible mushrooms (underground car park)

For the cultivation of edible mushrooms, a room with temperatures between 10 and 18 degrees is needed. A garage or laundry room are therefore ideal locations. Fluctuations between day and night are quite desirable. However, the room can also be dark or dim, as mushrooms need little or no light. A greenhouse is recommended for cultivation. (WELT.DE, 2013) Two French entrepreneurs have taken advantage of this in Paris and developed an underground organic farm concept. La Caverne offers a variety of edible mushrooms, endive lettuce and microgreens and also delivers them to order by bicycle. (La Caverne, 2017) Similarly, an example can be seen in Sydney, where various herbs, salads, etc. are offered in the underground parking of the EY building by the company Cultivate as part of a pop-up for EY employees. (ptc. consultants, 2018)



Fig. 14: Urban Farm Car Park © Henry Li

2.3 Challenges during implementation

From the planner's point of view

General

Conventional garages in existing buildings are only suitable to a limited extent for a variety of subsequent uses, as only subordinate functions are possible due to their room height and design. The poor to non-existent lighting conditions of the deep or underground structures also offer little quality of stay. Nevertheless, space can be created for alternative forms of mobility and functions that do not require people to stay permanently. The great flexibility due to the column structure allows a variable division of the interior space for new purposes. In the case of underground floors, the building above plays a decisive role. In the absence of a superstructure, ceiling openings can be cut in for lighting and ventilation, which would not be possible with a superstructure.

From today's point of view, conversion and re-use concepts are rather the exception and are rarely realized.

Technology

The simplest solutions can be realized by means of grid walls and surface installations. Possible consequences of the new uses, such as increased air exchange, higher electrical capacities, higher structural requirements, etc., must be taken into account. Air ducts and supply pipes can also be routed along the walls, in wall linings or between beams.

Building law

Any change in spatial use also involves a procedure in accordance with the building law. Different

requirements apply to each use and must be taken into account. At present, it is not possible to give up compulsory car parking spaces without further ado. The ownership situation must be clarified before the project begins, as each (co-)owner must give their consent.

Fire protection

A positive aspect is the generally good fire-protection partitioning from other building components and floors. Internal fire protection measures and escape routes, on the other hand, must be carefully examined, as they are rarely adaptable without additional structural measures. Additional smoke discharge openings would be necessary if the building is divided into several rooms.

Building physics

Due to possible climatic changes in the interior, adaptations to the exterior building envelope of the garage cannot be ruled out. Garages are not designed to be heated and thus do not have sufficient thermal insulation on the exterior wall to keep the dew point under control and prevent condensation.

Commuter movement in garage occupancy

Vienna has always been considered the cultural and especially the economic center of Austria. As a result of the EU eastern expansion rounds of 2004 to 2013, Vienna has increasingly moved to the center of Europe and has become an important business location for many large international companies and organizations. Vienna has thus developed into an attractive business location within Europe, whose sphere of influence has long since not stopped at the borders, but is also highly relevant for Austria's eastern neighbors - especially as a provider of many jobs.

Accordingly, it is hardly surprising that Vienna also attracts a large number of workers who live outside the city limits. The resulting commuter flows have increased significantly in recent decades, which can lead to problems and also to conflicts over the use of public space within the city.

Commuters are people (employed persons) whose place of work is outside their district of residence and who therefore have to cross a political-administrative border to get to their place of work. (Scheiner, 2016) According to this definition, for example, from the perspective of Vienna's 9th district, all those employees who come to work in Alsergrund from the federal states or from abroad are considered commuters, but also those who commute in from Vienna's 2nd district. Of the almost 674,000 employed persons in Vienna, more than 180,000 people come from outside the city limits of Vienna, not even a third of them use public transport to get there. This means that more than 120,000 vehicles commute to Vienna every day (Seisser, 2016) and these need to be parked.

This circumstance leads to the fact that, as already mentioned in the contribution to "Trends and Visions" as well as at the beginning of chapter 1.1, the parking situation in the city of Vienna is very strained and often too little public parking space is available for the motorists.

In this case, it would be important to expand public connections between Vienna's surrounding areas and the city as well as additional well-thought-out mobility concepts.

Guidelines and laws

Whether existing parking spaces can also be used alternatively always depends on the respective existing ownership structure of the building or the space: While in the case of sole ownership, it is basically possible to act freely and observe "only" the general provisions, such as building and trade regulations, in the case of (simple) co-ownership, the consent of all (simple) co-owners is usually required. The situation becomes more complicated if condominium ownership has been established on the property and the parking spaces are independent condominium property (more on this in Chapter 1.2).



3. NEW CONSTRUCTION

3.1 Status quo

In contrast to existing garages, there is an immensely greater potential in newly planned garages and parking areas to make them fit for the future and to think about a second life for them already at the time of construction. Nevertheless, it was found that more intensive work is currently being done on conversion and re-use concepts for existing garages than for new buildings. Why is this so? Because a garage that has already been built and has a high vacancy rate incurs costs. This increases the pressure on those involved to act. This is missing in the planning of new buildings. In Austria, there are no transnational demands or efforts to think along with after-use concepts and to let the findings flow into the planning and implementation. Therefore, the share of parking areas that are built today and can be used for various purposes in the future with reasonable effort and, above all, without demolition, is manageable.

However, if we look at the status quo of mobility management, there are already many considerations in Vienna, for example, that help plan the future of garages before they are built.

Changing framework conditions in housing construction and new challenges for the climate change, require completely new mobility approaches and solutions. It is not enough to simply provide the premises with car parking spaces. A wide variety of mobility needs prevail, which also require future residents to have a variety of ways to be mobile. Therefore, it is important to respond to the needs of the residents with customized mobility concepts in new building projects. It is important to set the course as early as possible in order to be able to provide the spatial and financial framework conditions for such offers. Taking care of the issue of "mobility management" at the interface between housing developers and the administration has proven its worth in Vienna.

Acting as a hub between the city, project developers and mobility service providers, UIV (Urban Innovation Vienna) tries to be active on behalf of district planning and to help shape the framework conditions for new mobility offers. In doing so, the type of offers and their dimensions have to be specified in mobility concepts (mostly carried out by planning offices), the spatial and financial as well as organizational implementation has to be secured in competitions, urban development contracts, etc., and finally their implementation has to be monitored and evaluated. In this way, new mobility offers are being considered in most of Vienna's larger urban development areas. Through the accompanying research of various programs and projects as well as the handling of a grant from the Vienna Eco-Electricity Fund in the sharing area (innovative energy-efficient mobility measures in housing), a great deal of know-how could be built up and the knowledge could be passed on to numerous property developers. The more diverse the offer and the better it is communicated from the beginning, the more likely it will be accepted and reduce the dependence on motorized private transport. However, the backbone of all offers is still the connection to public transport and the high diversity of use in the neighborhood (keyword "city of short distances"). An overview of possible mobility management measures can be found in the Guide to Mobility Measures in Housing: Overview and Planning Recommendations for Housing Projects in Vienna. (City of Vienna, 2019)

These concepts do not primarily address the conversion of a garage, but rather the longest possible use of the space through intelligent planning and the promotion of alternative mobility. This approach is also justified in order to use the building as efficiently as possible for as long as possible and to avoid future vacancies.

3.2 Conversion and re-use concepts

The mobility behavior of our society is constantly changing. Our attitude towards individual transport is changing, especially as a result of the climate crisis that has come to the public's attention. One thing is certain, the way, how often and with what means we move from A to B will change in the future. Therefore, the serving elements of this mobility, in our case garages and parking areas, must also undergo this change.

Based on a decreasing demand for car parking spaces in garages, below are some ideas for after-uses that may be worth considering later. Many of the points are essential from a social and ecological point of view, but not feasible from an economic point of view at the beginning. However, as mentioned earlier, it is essential to think far beyond the initial use of the structure at the planning stage and to avoid designing and building any obstacles that may make future conversion difficult or impossible in the first place. The following are examples of conversion and re-use concepts, which are divided into three categories: realistic, creative and utopian approaches. It is important to allow for this entire spectrum, because what is utopian today may already be necessary in the near future. The challenge of this way of thinking is discussed in the next chapter. In addition, a realized project and a conceptual approach to conversion and re-use will be shown.

Exemplary conversion and after-use concept ideas

Realistic approaches - already feasible now with minor adaptations

- » Logistics areas (decentralized small storage areas, filling and distribution with small cars or two-wheelers)
- » Bicycle garage/alternative Mobility (separation by means of mesh walls, barriers)
- » Storage rooms (separation by means of mesh walls)
- » Go-kart, various leisure activities (dance studio, sports hall, games hall, etc.)
- » “Agricultural” use (cultivation, packaging and distribution of various types of vegetables, mushrooms and roots)
- » Fish farming
- » Workshop/studios (in the case of multi-story garages with natural light)
- » Solar power plant (depending on facade and orientation)
- » Data centers
- » Automated production facilities

Creative approaches - only possible with technical preparations and, in some cases, changes to building regulations

- » Logistics areas (decentralized small storage areas, filling and distribution with small cars or two-wheelers)
- » Bicycle garage/alternative Mobility (separation by means of mesh walls, barriers)
- » Storage rooms (separation by means of mesh walls)

- » Go-kart, various leisure activities (dance studio, sports hall, games hall, etc.)
- » “Agricultural” use (cultivation, packaging and distribution of various types of vegetables, mushrooms and roots)
- » Fish farming
- » Workshop/studios (in the case of multi-story garages with natural light)
- » Solar power plant (depending on facade and orientation)
- » Data centers
- » Automated production facilities

Utopian - with a lot of effort and centrally controlled

- » Underground cities by combining several garages
- » Ice banks
- » Connect underground garages and allow unmanned smaller vehicles to drive autonomously
- » “Sleeping places” and recharging stations for AI machines
- » Temporary housing, living and working space due to overpopulation

However, not only holistic conversion and re-use are approaches to sensibly utilize vacant parking spaces in the future, but also the supplementary use of partially used spaces represents a justified approach. This means that garages are already being planned today in such a way that future partially vacant spaces can very easily be filled with complementary uses without irritating the parking spaces still in use or getting into a conflict of use.

The large international participants in the parking market in particular are already intensively dealing with these concepts for conversion. The APCOA Urban Hubs can be mentioned as an example of a general approach. (APCOA Parking, n.d.)

This concept is particularly concerned with the following points, whereby it should be mentioned that these concepts can be planned from the outset, prepared for later conversion and re-use, or implemented in existing garages with greater effort. Development of areas that are not (or no longer) used for:

- » Storage
- » Collection boxes
- » Charging infrastructure for micro-mobility



Fig. 15: APCOA Parking Sweden (2022), Abholboxen

Use of temporarily unused areas, e.g. at night for:

- » Distribution logistics
- » Temporary storage for last-mile logistics
- » Parking of distribution vehicles during night hours
- » Storage possibility e.g. via stowage boxes

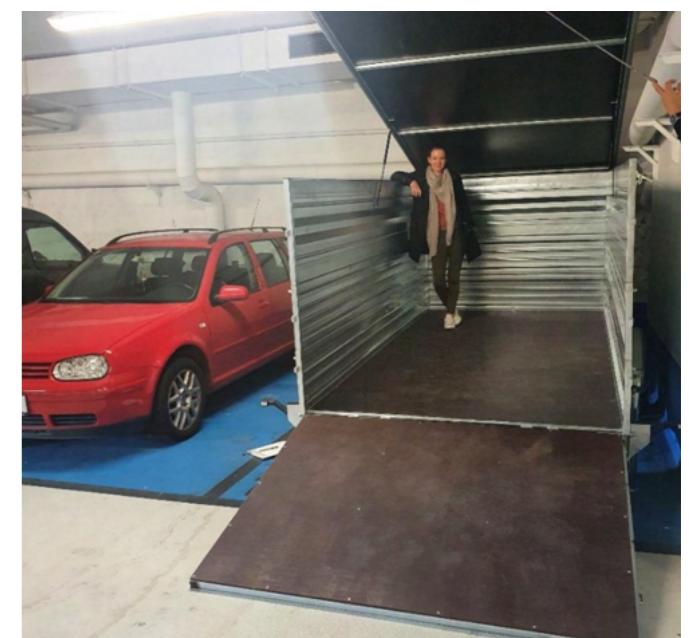


Fig. 16: APCOA Parking Austria (2022), Storage Box (storage in car parking spaces)

Conversion of (no longer used) partial areas for:

- »Charging hubs for the B2B and B2C sectors. Here, a parking garage becomes a mobility hub, creating a range of mobility and logistics services with economic and environmental benefits. As an example, mention should be made of a project from London - Q-Park, which has implemented this concept. (<https://www.q-park.com/showcases/newsitem/16461/london-mobility-benefits-from-park-lane-hub-services>)
- »Storage space including cold storage for online supermarkets and their distribution logistics.

As parking garages are naturally well connected to the public road network, this is a good alternative to traditional use. One example is the implementation of this concept by the Indigo Group in France and Spain. Here, cold storage rooms, click & collect areas and urban logistics centers were created. (<https://www.group-indigo.com/en/metier/logistique-urbaine/>)

»“Dark Kitchens”, where meals are prepared for delivery services. Here, several so-called “brands” are often served from one “kitchen”. The delivery to the end consumer should be quick and warm. An example is REEF from the UK. (<https://reeftechnology.com/kitchens>)



Fig. 17: Reef Technology (2022), Dark kitchen



Fig. 18: APCOA Parking Denmark (2022), EV Charging

Example of a realized project

A realized project in Austria, which not only functions as a mere garage, but also provides other services, should be presented at this point. Due to the high clearance heights, other uses beyond parking have also been made possible in the future.

This economically implemented solution offers both logistics and parking areas and was implemented in Vienna at the Donaumarina multi-story car park. Here, a product of a German supplier of prefabricated building components was used. Approx. 500 parking spaces for cars are offered from the 1st upper floor. The lowest level is designed with storage facilities, access is possible with lorries thanks to the high clearance height and secured with a parking clearance system. Video surveillance systems ensure a high level of security.

In addition, the car park is prepared for the installation of a large number of charging points for electric vehicles.



Fig. 19: Wehli Verwaltungs GmbH (2022), Car park Donaumarina, Vienna



Fig. 20: APCOA Parking Austria (2022), Logistics area with barrier handling system



Fig. 21: APCOA Parking Austria (2022), Access to the logistics area

Conceptual approach to conversion and re-use

The model: District garage (with garage operator)

The model of district garages can have a positive impact in many ways. The study "District Garages in Berlin", completed and published in 2018, deals extensively with the advantages of collective garages - especially multi-story garages - and several projects that have already been implemented. The study was prepared by LK Argus GmbH on behalf of the Berlin Senate Department. The approx. 20-page study and several appendices, including a collection of garage examples, can be found on the website of the Berlin Senate Department for Urban Development, Building and Housing. (Senatsverwaltung für Stadtentwicklung, Bauen und Wohnen Berlin, n.d.) For the implemented examples, the advantages of district garage solutions are pointed out in a technically well-founded manner. The implementation of such collective multi-story garage solutions not only contributes to cost savings for developers (as underground garage spaces are very expensive to build), but also strengthens the social fabric in new districts, as more people travel by environmental means and thus move around the urban space. In addition, higher-quality green spaces can be created and mobility in, out and into the district can be handled more sustainably. This approach is being successfully pursued in many German cities. In Vienna, there are also already the first successfully implemented district garages that combine more or less many uses. The best-known example is the urban development project Seestadt Aspern, where several hybrid garages have been and are being built and, in addition to parking, are also used as sports facilities, cultural venues, etc.

The basic principle of the district garage is that of equidistance: residents can park their own vehicle in a district garage that should be a maximum of about 500 m away so that they can reach it within a few minutes' walk. Closer to home or at most the same distance as neighborhood garages, environmentally sustainable forms of mobility should be available for use, such as shared cars, public transportation, or a well-developed safe bike path.

Particularly if district garages are built in the form of multi-story garages and the construction of underground garages under individual residential

buildings is eliminated, i.e. developers can provide evidence of required parking spaces in the district multi-story garages and reserve them for their residents, major cost savings can be achieved (the construction of a parking space in an multi-story garage, built in modular prefabricated construction, can amount to € 10,000 compared to parking spaces in underground garages, which can cost from € 25,000 up to € 50,000 depending on the nature of the subsoil and the dimensions).

In addition to being cheaper to build, multi-story garages offer other advantages over underground garages. Hybrid uses are easier to implement - for example, the ground floor zone can be used for business premises, but also for sharing mobility services or parcel stations. Concerns from an urban planning point of view that multi-story garages with their monotonous, closed facades would impair the experience and aesthetics of the urban space can be countered with the use of ground floor zones (see, for example, multi-story garages in the Sonnwendviertel), but also with the artistic design of facade elements (e.g. Kulturgarage Seestadt Aspern) or ecologically positive measures such as wooden facades or green facades. The upper floors or the garage roof can also be used.

As with many other roofs, the installation of photovoltaic systems is an option, but offers for residents can also be implemented (see football pitches on the roof of the "Seehub" garage in the Seestadt Aspern).

It should be noted that for some hybrid uses, additional fire protection requirements must be taken into account or the building structure must be adapted to the roof use, for example. Rooms in the ground floor zone, for example, are relatively easy to implement - in the case of garages that are built in prefabricated construction, the rooms can be "pushed" as modules under the supporting steel framework.

In order to be able to guarantee economic operation, professional garage operators should take on the task of exploiting and operating parking spaces and other uses. Property developers whose core business is the construction of residential and commercial space can thus be relieved of this additional task of garage operation.

At the end of 2020, Urban Innovation Vienna organized an expert dialogue on collective garages. During the

district. Not least because land could be used for other purposes in case of doubt. However, there are some legal and financial challenges to implementing such solutions in Vienna (see recording of UIV expert dialogue), which would have to be overcome.

Conceptual approach to conversion and re-use - the dismantlable multi-story garage

Especially for the construction of parking areas, which are already known to have a limited lifetime, the approach is to consider serially prefabricated multi-story garages that can be dismantled again. The advantages of such a construction lie on the one hand in the fast construction time - the elements are prefabricated or are already in stock and can be assembled within a very short time. When the temporary use is over or the need changes, the multi-story garage can be extended, partially dismantled or completely removed. But this system can also be used to add capacity to an existing multi-story garage. Assuming that there will be a change in demand for parking spaces in the future, this is an optimal solution to cover today's demand and to think about adapting to the change in demand in the future. A good example can be found in the trade fair car park in Nuremberg. With the help of the modular Preflex® multi-story car park concept from CHRISTMANN + PFEIFER, temporary parking space for 850 vehicles was created here within 3 months. (Christmann + Pfeifer, n.d.)



Fig. 22: Multi-storey car park main station Vienna
© David Schreyer



Fig. 23: Culture garage Seestadt Aspern
© H. Schimek/fasch&fuchs.architekten/aberjung

event, the study was presented by Johanna Hoffert, staff member of the Senate Department. (Urban Innovation Vienna, 2020) The event ran under the series "Urban infrastructure for the mobility of the future". If we are to succeed in the mobility transition, then new approaches must also be found for parking private vehicles and the topic of mobility must be thought of in a more integrated way. Multi-story garage solutions for the collective parking of cars have the advantage that they are cheaper to build, can be used in a hybrid way and also serve as a more sustainable solution for



Fig. 24: Christmann + Pfeifer Construction GmbH & Co. KG, Nuremberg car park built with the Preflex® system

Conceptual approach to conversion and re-use - "planning the other way round"

A very interesting approach to designing new parking space is the one described below. Instead of half-full garages, easily replaceable pop-up functions are to be realized first. Should the demand for parking spaces arise, then only the concrete spaces need to be cleared and prepared for use. In doing so, the garage shall be filled one parking space at a time. From the beginning lightweight walls with plug-in or screw connections form the room partitions. Easily movable furniture and room dividers can serve as temporary boundaries. Sprinkler systems replace costly fire protection measures. However, the possibility of flexible multiple uses in garages must be created legally, and ownership must also be regulated. The technical implementation seems to be given. Two major advantages of this approach are, among others, that only as much space is used for parking spaces as is actually needed and that, if necessary, individual parking spaces can be turned into storage areas, storage rooms, in-house farming, playrooms and workshops by simple means.

3.3 Checklist for planning phases

Especially with new buildings, the opportunity to construct future-proof buildings is particularly great and must not be missed under any circumstances if the issues of sustainability are to be taken into account. An important point is to plan garages and parking areas as efficiently and space-savingly as possible and to consider conversion and subsequent use in this process. The argument of the resulting higher costs during construction must be countered by the fact that a property that has to be demolished after a certain, usually far too short period of use, is also very cost-intensive. Unfortunately, when planning decisions are made, all too often only the construction costs are taken into account without balancing the follow-up costs of the decisions.

In order to facilitate the decision-making process and the resulting planning, the following is a checklist of the most important topics that are necessary for the second life of a garage. The list does not claim to be complete - there should be no limits imposed on the creativity of all those involved.

1. Architecture

- » Provide possibilities for later lighting/ventilation
- » Position staircases in the center of the building
- » Room heights
 - » > 2.70m for residential use
 - » > 3.20m for public use
 - » Room height > 3.20m for multi-story garages, especially on the ground floor
- » Consider ramp length
- » Use lightweight construction
- » Entrances and accesses can be extended
- » Provide space for wall linings and suspended ceilings
- » No load-bearing exterior walls in multi-story garages

2. Structure

- » Oversize supporting structure
- » Removable ceiling panels
- » Modular construction
- » Column grid
- » Consider loads and possibilities for balconies

3. Building services

- » Design energy concept and capacities for later use
- » Provide for expansion space in the basement
- » Increase size and number of building services shafts
- » Use empty pipework
- » Oversize supply and disposal pipework
- » Larger lifts

4. Fire protection

- » Wider entrances, also for larger groups of people
- » More escape routes
- » Expandable smoke exhaust openings
- » Create smaller fire compartments because of later subdivision

5. Building physics

- » Provide external insulation of the basement walls

3.4 Challenges in implementation

There are many challenges in implementing adaptable, reusable parking. The most important ones from our point of view are listed below as food for thought:

Challenge 1: One-sided consideration without true cost and consideration of the impact on people and the environment.

As already mentioned in the previous chapter, the price pressure is often the decisive argument, due to which no or only very little adaptation strategies are developed and implemented for after-uses in general and for garages in particular. Until there is true cost across the life cycle, construction costs will continue to be a weighty factor in the decision. The solution to this is a life cycle cost analysis, as well as the evaluation of demolition and new construction costs for subsequent buildings.

However, not only costs can be balanced, but also the impact of buildings on the environment. The environmental impact of a property can, should and must be taken into account during the planning stage. This is done in the form of a life cycle assessment, which shows the resource and energy input and the output of emissions over the entire life cycle. This approach promotes sustainable planning and makes it unnecessary to demolish a garage after a short period of use. The best thing that can be done in terms of sustainability is to use the buildings that have to be constructed for as long as possible and to design them in such a way that the user feels comfortable in them and finds the building functional.

Challenge 2: Lack of demand for after-use concepts on the part of subsidies, the public, tenderers

Every idea and every new trend needs pioneers who turn these ideas into reality. Unfortunately, tenders, specifications from funding agencies or

public authorities still too seldom demand after-use concepts when planning new garages and parking areas. People still only think in terms of the utilization phase of a building and plan accordingly. In this way, great opportunities and a lot of potential are missed.

Challenge 3: Evaluation of the sharing offers - why are they accepted or not?

One of the key aspects of sustainability is the 3E principle. Saving energy where possible (sufficiency), using energy as efficiently as possible where this is not feasible (efficiency), and obtaining the energy that is needed and can no longer be saved from renewable sources (consistency). This principle can be applied to many sustainability issues - including mobility and the associated resource flows. Material can be saved by not everyone owning their own car, but if a means of transport is needed, use one that can be operated efficiently and make those journeys that have to be made as environmentally friendly as possible. Sharing offers are a good instrument for this.

Often, however, the utilization figures of sharing offers in cities still fall short of expectations. Although there are various car-sharing services in cities (in large cities often station-based and free-floating car-sharing), for various reasons they do not represent an alternative to owning a car or a supplement to other means of transport in the environmental network. Reasons can be that the offers are not known, i.e. above all not visible, the use is considered too complicated or the tariffs are perceived as not suitable for one's own needs or as too expensive. The concern that no vehicle will be available when needed is also raised as a hurdle in the use of such offers.

» Within the framework of the study "Mobility Measures in Housing plus" (MMWplus), which

was carried out in 2021, the accuracy of mobility measures in housing, in particular of sharing offers, was examined on the basis of Viennese districts. The following recommendations for the improvement of sharing offers were developed, which can also be transferred to other cities:

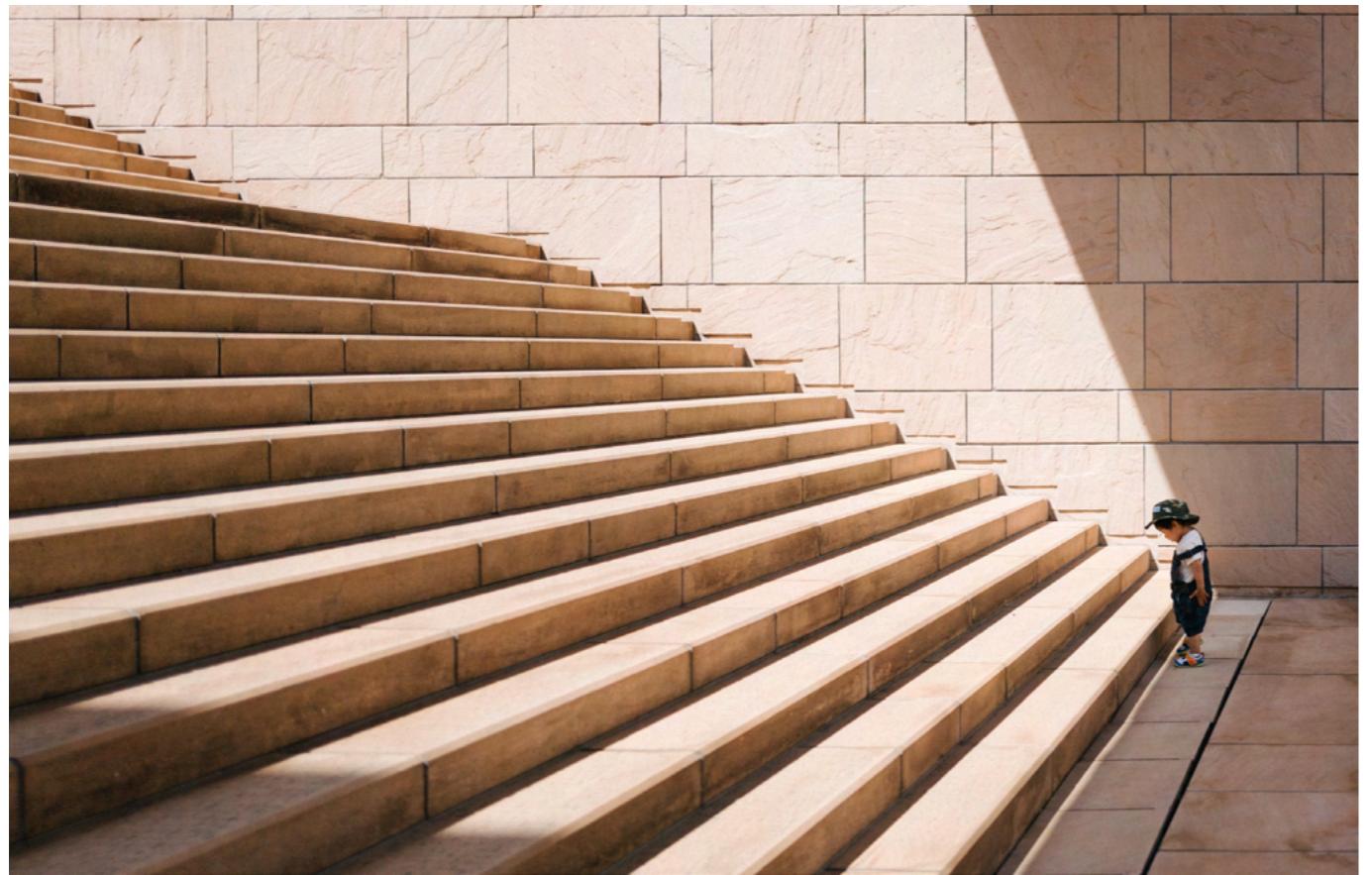
- » Establishment of an "umbrella brand" within which existing mobility providers provide services - in a uniform corporate design and with uniform quality criteria; ideally, these are the providers of public transport services who increasingly see themselves as comprehensive mobility service providers.
- » Determine positioning of mobility services in time during planning, define qualities in the course of legal procedures
 - o In the future, mobility services in residential buildings should no longer refer to a single residential complex, but should include residents and businesses in the surrounding area.
 - o Offer mobility services on publicly accessible private land (contract zoning regulations) and localize mobility measures on the ground (not in underground car parks) to increase visibility.
 - o Establish offers block by block also in existing areas, bundle mobility stations / sharing offers on clearly defined parking areas in the neighborhood / district in public space.
- » Simple and uniform tariff structures; ideally, services at all mobility stations in a city can be simply added to existing public transport tickets at a standard monthly price.
- » If the existing mobility services in the housing complex are to be continued in the long term, the legal framework conditions are required in the direction of ongoing operating cost support by the property developers. Otherwise, the developers, administrators and mobility service providers may not be able to continue them. Sharing services would then no longer find a place in combination with housing, but only in public spaces.
- » Implementation of a significantly larger number of sharing vehicles with a more restrictive parking space regulation - rolled out throughout the entire district and across the board

Challenge 4: Combining long-term and short-term parking - how to deal with visitor parking? Just as many privately used cars are parked most of the time instead of being driven, many parking spaces are not in permanent use.

In general, it can be said that garages in which parking spaces are not permanently allocated to long-term parkers offer great potential to accommodate more vehicles in a space-saving way. A certain number of parking spaces can be allocated to several long-term parkers - even in garages that are mainly used by long-term parkers. It can be assumed that not all long-term parkers always use their parking space. Parking spaces that are not permanently allocated can also be used by short-term parkers. Put simply, some of the long-term parking spaces that are not used during the day because cars are mainly used for the journey to work can be used by short-term parkers. Reference examples of existing garages provide information about the proportion of long-term parkers who regularly use the vehicle during the day and can thus be used for the management of new garages. So-called daily hydrographs of garages with a predominantly resident population show that in the morning peak, for example between 7 and 8 a.m., 20 % of long-term parkers leave the garage and in the afternoon peak between 5 and 6 p.m. the majority of these return. Ideally, a garage in a (mixed) district can be used during the day by businesses for their employees, customers of shops and general visitors, and from evening to morning by residents - i.e. daily trajectories of different user groups are complementary to each other.

The renting of parking spaces that are not permanently allocated to short-term and long-term parkers is already practiced in this way in many residential quarters (e.g. in collective garages in the Seestadt Aspern).

With digitization, check-in systems have become alternatives to high-maintenance and often more expensive systems (e.g. payment machines, parking tickets) thanks to automatic number plate recognition or cashless payment for short-term parkers. With lean check-in solutions, short-term parking can also become a profitable addition in residential garages with a predominant share of long-term parkers.



4. DEMANDS

The previous chapters show that we already have to deal with the future of garages and parking areas today. This applies to both existing and new buildings. In order for conversion and re-use concepts to work today, the working group makes the following demands.

Demand 1

Reactions to the Climate Roadmap of the City of Vienna (max. 250 cars per 1000 inhabitants by 2030) - Adjustment of the parking space requirements

In the Vienna Climate Roadmap, the target was set to reduce car ownership to a maximum of 250 cars per 1,000 inhabitants by 2030. This means that special attention must be paid to this value, especially in new buildings. In other words, the parking space requirements in new buildings should not actually exceed the target value. This could be achieved, for example, by lowering the parking space requirements in principle, or by imposing a different parking space solution depending on the actual local need for parking spaces.

The following illustrative example shows the discrepancy between the current specifications of the parking space requirements and the objectives according to the Climate Roadmap. For the calculation, data on planned gross floor area/usable living space, average apartment sizes and number of occupants (household sizes) are required. A building with 10,000 m² GFA, 7,500 m² living area, currently has to provide 75 compulsory parking spaces according to the ordinance. This corresponds to approx. 107 apartments with 2.2 persons each and a total of 215 residents. For this number of residents, only parking spaces for a maximum of 53 cars would be necessary to meet the objectives of the climate action plan, i.e. only about 70% of the obligatory parking spaces.

The example shows that, especially if the general conditions such as public accessibility are suitable,

the existing specifications of the parking space requirements are no longer up to date. An adjustment is therefore urgently recommended. In the future, not only the residential floor area could be used for the calculation, but also other data such as public transport connections could be taken into account (e.g. on the basis of public transport quality classes).

Demand 2

Adjustment of the parking space obligation to the changing demand or shift of the authorized users

The parking space requirement of the state of Vienna provides for the mandatory provision of at least one parking space per 100 m² of living space. However, many residents - the number has steadily increased in recent years - do not own a vehicle themselves and thus the parking space available for the corresponding residential unit remains unused.

We therefore demand that, in the course of the parking space ordinance, it must also be ensured that the corresponding garages are made publicly accessible so that the owner can thus achieve additional returns through sharing or short-term parking rental. At this point, the parking solution of PAYUCA can be mentioned as an example, which can be used to manage free parking spaces in buildings.

In this case, it would be possible to soften the parking space requirements (in conformity with the constitution, of course) in such a way that either the number can be determined by ordinance based on demand or the number can be reduced if certain measures such as the introduction of a well thought-out mobility concept (scooters, mopeds, cars, bicycles) are introduced (see the example of Berlin or demand 4). An overlapping of uses supports making the best use of already built-up areas and thus tackling major urban policy challenges as well as promoting sustainable positive development.

Demand 3

Re-use of vacant short-stay parking zones - reclaiming street space for the residents of a city.

A possible shift of short-stay parkers from the street to parking garages through parking space sharing offers enormous potential for public space. It is important to use this actively and promptly or to decide on and initiate appropriate measures.

A large number of short-stay parkers now use the garages instead of the short-stay parking zones at the roadside, which means that many outdoor parking spaces are empty and remain unused at present. This is exactly the point that should be addressed. As time goes on, many parkers will soon switch back from garages to parking areas in public spaces if the current conditions remain unchanged.

A reaction should be taken even before this happens. (Rosenberger, 2014) This means that former parking areas should be redesigned as soon as possible in order to make them available to the population in a meaningful way and to enable new, diverse forms of use. For example, newly constructed meeting zones in the city, comprehensive unsealing and greening, which can also be a significant factor in cooling the city in summer, but also high-quality design through art would be conceivable here. All these measures contribute significantly to improving the quality of stay in public spaces.

Some cities in Europe are already showing that the conversion of old parking areas can greatly improve the quality of life for local residents, examples of which are illustrated in the diagram below.



Amsterdam



Barcelona
"Superblock"



"Begegnungszone
Neubaugasse"

1,500 parking spaces will be eliminated each year until 2025.

Instead, bike paths, parking spaces and green areas are created.

Streets and parking lots were upgraded to valuable habitat.

Playgrounds and green areas were built on the 8,000m² area.

The road was paved barrier-free and the roadside planted.

New trees provide shade and more than 100 seats invite you to linger.

Fig. 25: Inspired by a graphic of PAYUCA GmbH (2022), Reclaiming urban living space

Demand 4

Exchange parking space for sharing offer

The construction of parking spaces in garages is very cost-intensive. Construction costs for parking spaces in "simple" underground garages amount to several thousand euros per parking space and can at least double for multi-story underground garages and technically complex retention of groundwater. Garages, especially in residential buildings where permanently allocated parking spaces are rented to long-term parkers, can rarely be operated profitably. In homeowners' associations, parking spaces are usually partitioned and thus sold to individual apartment owners. As a result, its use as a parking space is set in stone for a long time, if not forever. This means that an important traffic policy control function is lost. Often the developers want to build fewer parking spaces - but a "reduced parking space solution" (in Vienna parking space regulations) is not always applied. As a result, accuracy is lost and sometimes too many parking spaces are built or they are often no longer needed due to changing household structures. The mobility offers in Vienna should be fair, healthy, compact, ecological, robust and efficient according to the Mobility Concept of the Urban Development Plan 2025 (STEP 2025) adopted by the Vienna City Council. It is about being "mobile together". Vienna's transport policy therefore consistently focuses on promoting the environmental alliance and aims to increase its share in the modal split to 80% by 2025. An important step towards achieving this goal is the promotion of multimodal mobility offers. The establishment of mobility stations is a measure to achieve multimodality according to the mobility concept. Mobility stations favor the implementation of "Mobility as a Service" (MaaS). With regard to the topic of the ÖGNI working group, one advantage of mobility stations in particular should be emphasized, namely the reduction of parking spaces. (City of Vienna, 2018)

At this point, it would make sense if property developers / project developers were to include in the building laws the possibility of being able to "exchange" compulsory parking spaces for a car-sharing offer. A shared car can replace up to 8 individual cars. A garage sharing service can encourage people to own fewer cars and is also more socially just, as it means that people who cannot afford a car do not have to do

without appropriate mobility. In some German cities, such a regulation already exists in the local parking space statutes. A corresponding possibility could be designed like this:

1. Deal: project developers co-finance sharing vehicles or expand the already locally available existing mobility concept and therefore have to provide evidence of/ build fewer parking spaces (cost advantage: approx. € 25,000 - € 50,000 per parking space).

2. Establishment of sharing offers in garages plus operating guarantee over a certain period (e.g. 5 years). Preferably e-car sharing (incl. charging infrastructure (can be operated by the company itself or by an external operator). In return, reduction by a certain number of compulsory parking spaces (e.g. 1 CS vehicle saves 5 car parking spaces).

A change in the respective building laws would be necessary, in Vienna e.g. the Vienna Garage Act 2008 as part of the Building Code for Vienna.

Demand 5

Commuter allowance vs. promotion of the use of public transport - reduction of land consumption

The topic of land consumption was discussed a lot in the working group. The fact that there is a slow change of mindset in the population as well as in politics is already visible. Among other things, the EU Taxonomy Regulation brings about many mandatory changes. Nevertheless, additional legal framework conditions and, much more challenging, a change of values as well as awareness raising are needed in Austria to counteract the problem.

It is a fact that Austria is the European leader in land consumption. More than twelve football fields are consumed for development on every day. In an article for Der Standard, Arthur Kanonier, an expert on land and spatial planning policy at the Vienna University of Technology, emphasizes that the pressure on land has increased enormously in recent years, mainly because building in Austria is still seen as positive. A single-family house with a double garage is still considered a status symbol by many, but awareness of the problem has not yet penetrated the population. Yet the solutions are already on the table in many places. In the future,

for example, land could be used for multiple purposes, such as agroforestry, in which trees are also planted on agricultural land, which benefits biodiversity and the microclimate. Or agrophotovoltaics, in which PV systems are combined with agriculture, could be expanded. However, these areas are only available if parking spaces for individual transport are reduced.

According to Kanonier, there is a need for stronger supra-local settlement limits and criteria in which the land function is more strongly incorporated, instead of placing zoning only in the scope of responsibility of the municipalities. In addition, about 30 per cent of the designated building land is currently undeveloped. One possibility would therefore be to re-designate these areas as grassland, which, however, raises difficult questions of fundamental rights. It would also make sense to rethink housing subsidies or the currently increased commuter allowance, which promote structures that again lead to more land consumption.

Last but not least, new ideas are needed on how land can be reused. After all, there could be even more empty shopping centers standing like shells on the outskirts of cities in the future. However, there is currently a lack of reliable and valid data on vacancies in Austria.

If we succeed in reducing land consumption, this could mean more quality of life and recreational space for everyone. Kirsten Von Elverfeldt, geographer at the University of Klagenfurt, emphasizes that in the future we should ask ourselves with every new house, every car and every road whether we need them at all now or in the future. Because this infrastructure will continue to influence our climate and our environment for the next hundred years. The window of opportunity for change is closing fast. (Pallinger, 2022)

Demand 6

Inventory / cadastre of existing garages incl. vacancy rate

In order to be able to determine the actual potential as well as the necessity for re-use and conversion concepts, the working group demands an inventory or cadastre of existing public parking garages as well as a survey of the current vacancy rate (also of non-public residential garages). Currently, there is no independent and reliable data on how much parking

space is actually always or temporarily unused. It is also interesting to analyze what the reasons are. For example, are there areas where garages are always at capacity and if so, why and how can this increased demand be meaningfully countered. In contrast, there are areas where parking spaces are underutilized. What measures, such as deconstruction or other use, can be implemented here.

Demand 7

Extension of regional planning agreements

If parking spaces could also be reduced by concluding regional planning agreements, this would be another alternative to ascertain the respective need for certain infrastructure on site and to integrate the new construction into the existing conditions.

In Vienna, the reduction of parking spaces would thus have to be included as a planning objective in paragraph 1 para 2 Vienna Building Code, so that a private-law urban development contract could also be concluded on this. In return, the landowner would commit to providing mobility schemes or sharing services, which could expand existing schemes and absorb costs.

This would require - as already noted in the above demands - an amendment of the respective legal provisions.

CONCLUSION

We can only assume how garages and parking areas of the future will actually be designed. Nevertheless, current laws and directives as well as current trends show us that there is a need for action in the planning and construction of parking areas - today. The climate crisis, EU taxonomy regulation, changing mobility behavior, social change, and structural differences and needs between urban and rural areas - to name just a few underlying factors - indicate that the parking areas that already exist and are currently being planned and built will inevitably be subject to change. Since the construction of this infrastructure always means a long-term change in the environment, it is particularly important to plan prudently here. A distinction must be made between existing and new construction projects. On the one hand, existing buildings require sensible conversion and reuse concepts; on the other hand, concepts of this kind should already be considered - and planned - for today's new construction projects in order to be able

to facilitate conversion as easily as possible in the future.

This topic is confronted with many challenges, but there are already successfully implemented projects that provide future-oriented parking spaces in different ways.

However, changes in legal frameworks are also needed in this regard. The best idea and the greatest solution cannot be realized if the flexible approach is hindered by current building regulations or the like. A softening of the parking space requirements or even a deviation from them would mean a significant concession by the state legislature against the sealing of surfaces and for climate protection in terms of spatial planning and building law.

For this reason, the working group also formulated seven demands which, in our opinion, can lead to future parking areas being planned and built in a more future-oriented manner, in addition to the measures that are currently already possible.

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AUSTRIAN SUSTAINABLE BUILDING COUNCIL

The ÖGNI - Austrian Sustainable Building Council, is an NGO (non-governmental organization) for the establishment of sustainability in the construction and real estate industry. The aim of the ÖGNI is to demonstrate the added value of building certifications in order to create environmentally and resource friendly buildings, with high economic and social efficiency, which can be used flexibly over generations and have a positive impact on the health, well-being and performance of the users.

The ÖGNI was founded in 2009 and is a cooperation partner of the DGNB (German Sustainable Building Council), whose certification system was adapted to Austria and has been continuously developed since then. The ÖGNI is the only Austrian council that is an “established member” of the WorldGBC (World Green Building Councils) and strives to strengthen the European quality certificate on an international level.

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Schweizer Gesellschaft für Nachhaltige Immobilienwirtschaft



GBCe

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