Rainwater in the city

Technology Report

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Dear readers,

Vienna is one of the most successful metropolises in the field of sustainable innovations. In all, around 9,200 companies in Vienna are active in the field of urban and environmental technologies. Over 90,000 people generate an annual turnover of approx. 40 billion euros, i.e. 16 % of the total turnover of Viennese companies.

According to various studies, Vienna scores particularly highly on innovative strength, comprehensive support for start-ups and a strong focus on sustainability. Vienna also holds top positions in several “Smart City” rankings. The key objective of Smart City Wien[1] is to provide the best quality of life with the greatest possible conservation of resources by 2050. The Smart City Wien Framework Strategy is implementing this objective through many innovative individual projects. As a location, Vienna also wins approval with its research and technology-friendly climate, its geographical and cultural proximity to the eastern growth markets, the high quality of its infrastructure and educational system and, last but not least, the highest quality of life worldwide.

In order to make optimal use of the potential at this location, the Vienna Business Agency acts as an information and cooperation platform for Viennese technology developers. It networks companies with development partners and key customers from business, science and city administration and supports Viennese companies with targeted monetary subsidies and a wide range of consulting and support services.

The Vienna Business Agency supports you with the targeted promotion of smart business ideas and innovative solutions. Target groups are companies in the fields of energy and environment, mobility and construction as well as social innovations and assistive technologies.

This Technology Report provides an overview of the various trends and developments in the field of urban energy innovations as well as a selection of companies that are active in this field in Vienna.

The Vienna Business Agency Team

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www.wien.gv.at/stadtentwicklung/studien/pdf/b008551.pdf

Europäische Union. Investitionen in Wachstum & Beschäftigung. Österreich.

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1. Introduction

given very high priority in order to cushion the unavoidable consequences of climate change through appropriate measures as part of an adaptation process.

Such an adaptation process, with the aim of renaturalizing parts of the urban fabric as far as possible, also offers great opportunities for innovation. For this reason, the challenge "Rainwater in the City" was worked on last year as part of the Vienna Business Agency's 'Co-Creation Lab'. This report provides an overview of the current development of rainwater management in Vienna and presents the ideas and projects submitted within the framework of the 'Co-Creation Lab'.

In nature, where most of the rainwater is temporarily stored by the ground, about 75 % of the rainwater evaporates in the natural water cycle at the same place again, with vegetation playing a significant role. In settlement areas, where this cycle is interrupted by ground sealing and drainage via the sewage system, the proportion of evaporating rainwater is only about 5 %.

In light of this situation, the development of sustainable rainwater management is of vital interest for urban areas, as it should be able to deal adequately with an increasing number of extreme weather events such as heat waves and heavy rainfall. The declared goal of such a rainwater management system is to return as much rainwater as possible to the natural water cycle. This requires a partial unsealing of the soil, significantly more urban greening and additional local storage facilities for rainwater, which can then be used for irrigating plants.

This has several advantages: the rainwater that evaporates via the vegetation produces a cooling effect that prevents the formation of urban heat islands (UHI), provided that the system is of a sufficient size. In addition, this rainwater does not have to be drained off via the sewage system, thus eliminating the need for any pre-treatment and keeping the material pollution of ground and surface water as low as possible.

The City of Vienna endeavors to return as much rainwater as possible locally to the natural or near-natural water cycle. The Executive Office for Construction and Technology (MD-BD), the Vienna Environmental Protection Department (Municipal Department 22), the Vienna Water Management Department (Municipal Department 45) as well as the company Wien Kanal (en. Vienna Sewers) and others are working together to increase the use of sustainable rainwater management in Vienna. In the Smart City Wien Framework Strategy 2019–2050[2], rainwater management is being

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www.wien.gv.at/stadtentwicklung/studien/pdf/b008551.pdf

2. Rainwater in the city

The amount of annual precipitation in Vienna varies greatly. The reason for this is the topography, with the transition from the lowlands in the east to the wetter and rainier Vienna Woods mountains in the west. In the city center and immediately to the east, the average annual total is only 550–600 mm, while in the western districts the annual precipitation is increasing to about 900 mm/year, with an average increase rate of 100 mm per 100 m. Vienna's location on the extremely sharply defined border between the humid, rainy Vienna Woods and the dry plain in the east (Marchfeld), which has only slightly more than half of the Vienna Woods precipitation, has a direct influence on the amount of rainfall in the individual districts of the city.

Most of the precipitation water that falls on sealed surfaces in Vienna is discharged via the sewage system and – depending on whether this type of drainage is a combined system or a separation system – ends up either in the wastewater treatment plant or directly in the draining ditch.

The Vienna Green Space Monitoring 2005–2008 revealed that out of a total area of 41,667 ha, 30 % constituted sealed surfaces (12,496 ha, of which 5,646 ha are built-up areas and 6,850 ha are other sealed areas, e.g. traffic areas).[3] At first glance, this area may seem moderate, but the enormous annual precipitation that occurs only on this area and is withdrawn from the natural water cycle illustrates the need for action associated with sustainable rainwater management.

In addition, Vienna is a growing city. For example, between 1997 and 2005 alone, the sealed area increased by 555 hectares.[4] Now, due to climate change, not only has the number of hot days (days with temperatures of over 30 degrees) doubled since 1990, but also heavy rainfall events are becoming more frequent and sometimes more extreme. The expansion of the sewage system and the sewage treatment plant to cope with such events is neither technically possible nor economically reasonable. In addition, we should bear in mind that absolute protection from heavy rain events, irrespective of their intensity, is impossible in practical terms. The relevant systems – including the sewage systems – are designed for protection against events that are statistically expected to have a specific annual maximum. This means that there is always a scenario without any protection against more extreme events, though this also applies to near-natural solutions. For this reason, the discharge of rainwater into the public sewage system is only permitted to a limited extent or not at all in many areas of the city. The increasing sealing of surfaces also favors the formation of urban heat islands; the temperature difference from the surrounding areas sometimes reaches double-digit values.

For the growing city, a gap is thus opening up in terms of cooling requirements and rainwater drainage. However, as there is an opportunity to make sustainable rainwater management an integral part of the planning process, especially in newly developed areas, the Executive Office for Construction and Technology (MD-BD – Executive Group Construction and Technology) has published a guide for construction planning on the subject of surface drainage.[5]

This guide offers, in a clear, tabular form, an evaluation of the type of area and drainage for all built-up areas (such as roof areas, footpaths, cycle paths, unused spaces, parking spaces), as well as corresponding explanations, supplemented by the relevant legal requirements and framework conditions.

According to the guide, plans concerning the handling of surface water should always adhere to the following order of priority:

- Avoidance/minimization of sealed surfaces
- Retention and evaporation
- Percolation
- Drainage

How the different technical solutions are classified and evaluated in this context is shown in the figure "Sustainable handling of rainwater: "do's and don'ts": elaborate construction measures for the drainage of large amounts of rainwater are diametrically opposed to sustainable rainwater management. Moreover, they are very expensive and only combat the "symptoms".

3
www.wien.gv.at/kontakte/ma22/studien/pdf/monitoring-2005-1.pdf, S. 24

4
www.wien.gv.at/umweltschutz/raum/pdf/regenwassermanagement.pdf, S. 3

5
www.wien.gv.at/umweltschutz/raum/pdf/oberflaechenentwaesserung-leitfaden.pdf

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Sustainable rainwater management strives – in the city too – for a water cycle that is as close to nature as possible. The storage function of the soil is technically imitated, for example by green roofs or road substructures. The water is used to supply green roofs and façades or street trees. This increases the evaporation rate and counteracts the so-called “urban heat island effect”. The advantages of sustainable rainwater management are as follows:

- Water remains in the natural cycle.
- Rainwater supplies the soil, plants and groundwater.
- Rainwater evaporates, humidifying and cooling the air as well as binding dust.
- It avoids the use of drinking water for irrigation.
- Rainwater is purified by percolation through healthy, living soil.
- It fosters groundwater recharge.
- Technical and financial advantages through easing the burden on the sewers and the sewage treatment plant.
- Flood runoff and flood events are moderated because the runoff is delayed and reduced, thus decreasing flood damage.
- Natural, more consistent water levels of flowing waters.
- Low water and drought periods are mitigated through storing the water in the soil.
- Wetland biotopes are preserved or newly created. These provide a habitat for plants and animals.

The fatal effect of extensive soil sealing of an irreversible type can be seen, for example, in the megacity Tokyo. Here, gigantic underground storage basins had to be built in order to be able to discharge the rainwater collected on the sealed surfaces from the city in an orderly fashion. When one realizes that these billion-dollar construction measures are only intended to prevent the city’s sewage system from being overloaded and thus causing flooding, the economic effectiveness of sustainable rainwater management becomes clearer than ever.

In cities such as Vienna, we do not find situations on such a scale, but in the comparably large city of Munich, which – at 1,000 mm per year – records the highest amount of precipitation of all major German cities, the sewers and sewage treatment plants are overburdened during heavy rainfall, despite being designed for double capacity. In order to prevent contaminated rainwater from being discharged untreated into the River Isar in large quantities, 13 rainwater retention systems with a volume of around 703,000 cubic meters were built. This is equivalent to the amount of water that could be used to flood a soccer field about 70 meters high. This means that the rainwater can be transferred to the sewage treatment plant at a later date and in appropriate volumes.

In Vienna, too, there are now three underground rainwater storage basins, because such infrastructure measures are the only way to alleviate the impact of heavy local rainfall events – so-called “rain bombs”. This is where the problems brought about by climate change become apparent: extreme events are becoming more frequent and require adaptations to the increasingly undersized sewage system to increase its capacity. However: “Events of a century like the one on 13th August 2010 can be mitigated, but not prevented altogether.”[6]

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Europe’s largest sewer construction project in Simmering:
www.wien.gv.at/umwelt/kanal/baustellen/kanal-simmering.html

Sustainable use of rainwater: “do’s and don’ts”

Source: see www.wien.gv.at/umweltschutz/raum/pdf/oberflaechenentwaesserung-leitfaden.pdf, p.6

age space in both the large collection channels and in the sewage system as a whole.

The control and monitoring of the Vienna sewage system is supported by a computerized control system. This system works in real time, can react to all weather scenarios and switch to different operating modes, such as the delayed discharge of large amounts of precipitation during heavy rainfall.

Most of Vienna's urban area has a combined sewage system, which means that wastewater and rainwater are discharged together. The sewage system is 2,500 km long and transports half a billion liters of wastewater daily for 99.7% of the connected buildings.

Vienna's first underground sewage drains were built in the Middle Ages and flowed into the surrounding open watercourses. A systematic expansion of the sewage system was only begun in the early 18th century, so that the city had a nearly complete sewage system within its bastions by the middle of the 18th century. In 1830, the city center finally had about 20 km of sewers and the suburbs about 90 km of street sewers, to which 85% of the buildings were connected.

In the second half of the 19th century, the channeling of streams into enclosed vaulted ducts, the regulation of the Danube canal and the construction of collecting sewers took place. This sewage system ensured that no waters polluted by garbage flowed openly through the built-up area of the city. By 1914 the sewer network had grown to 900 km in length.

In 1980, the main sewage treatment plant for Vienna in Simmering was put into operation. With a biological treatment capacity of 95%, it can handle 500,000 m³ of wastewater daily in dry weather. The maximum intake capacity in rainy weather is 18 cubic meters per second, which is about 3 times the amount in dry weather. In 2000, the sewer network had reached a total length of 1,975 km.[7]

Climate change and the accompanying increasingly frequent heavy rainfall events pushed the sewage system in the 10th and 11th districts to its limits. In order to avoid overloading during such events, excess rainwater is retained in underground retention basins and then slowly released from this 86-million-liter storage system into the main sewage treatment plant.[8] The latter consists of three large storage basins or combined water retention areas, as well as additional stor-

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www.geschichtewiki.wien.gv.at/Kanalisation

8
www.wien.gv.at/umwelt/kanal/baustellen/kanal-simmering.html

4.1 The trend towards more extreme precipitation events

The impact of climate change on precipitation events is multifaceted: Warmer air can absorb more water vapor than colder air. In the typical temperature range of the atmosphere, this increase is about 7% per °C of temperature rise. This physical interrelation means that warmer air is also capable of producing more intensive precipitation.

However, as other determining factors for global weather patterns change, such as the jet stream, some areas experience greater fluctuations in annual rainfall and a different seasonal distribution over the year. The consequences are regional periods of drought but also local floods due to heavy rainfall.

The Hydrographic Service of the Vienna Water Management Department (Municipal Department 45) currently operates 20 precipitation and air temperature measuring stations distributed over the entire city area and equipped with data loggers. The measurement results of the past decades throughout Austria show that, with annual totals remaining more or less constant, the spectrum has shifted towards fewer, but more intensive precipitation events.

By definition, it is heavy rain when the height of precipitation in mm is greater than the square root of the duration of precipitation in minutes times 5 (information Municipal Department 45 – Hydrology Section). Thus, if more than 5 mm of precipitation fall in 5 minutes, this event is classified as heavy rain.

4.2 A high degree of sealing

If soils are sealed, all biological functions are lost. This process is difficult to reverse. The unsealing of soils is a costly and time-consuming process.

A high degree of sealing always means an increase in surface runoff and a concentration of runoff peaks. The consequence: increased risk of flooding with an increased probability of flooding in settlement areas. One hectare of functional (unsealed) soil can store 2,000 m³ of water. In the course of climate change, the number of heavy rainfall events, and thus also flooding, is increasing. The prevention of water percolation through the soil also prevents the filtering of pollutants from the water and increases the need for the drainage of surface water through a sewage system.

Loss of dust binding: Unsealed soils can bind dust particles. In cities and areas close to cities, where dust formation is particularly high, city soils make a particularly positive contribution to improving air quality.

Heat effects: Sealed soil cannot evaporate water. In settlement areas with high sealing rates, this leads to a change in the microclimate and an increase in local temperatures. Parks and "green islands" are therefore particularly important. In Vienna, there are about 480,000 trees on streets, in parks and between municipal buildings in the city center. In addition, there are more than 8,000 hectares of forest. There are more than five trees for every Viennese citizen. An average tree can evaporate about 100 to 500 liters of water per day in summer if the water supply is good. The effect on the water balance and the microclimate is considerable: a deciduous tree can cool the asphalt under its crown by up to 20°C and the ambient air by about 2°C.[9]

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vgl. wua-wien.at/naturschutz-und-stadtoekologie/baumschutz

4.3 The Sponge City

High temperatures and drought put trees under stress. The life expectancy of an urban tree under today's conditions (salt, compaction, lack of root space) is only 20 to 30 years. Depending on age and size, trees need a minimum water supply – up to 100 liters of water per day. One way to make it easier for trees to survive in the city is to expand the root space under the roadways – i.e. under streets, parking lots and sidewalks. Rainwater is stored and retained and is available to the trees for longer. At the same time, flooding during heavy rainfall events is mitigated or prevented.

For this purpose, the substructure must have a suitable structure that meets both the requirements of road construction and the demands of large-crowned trees.

In practice, load transfer is achieved by installing coarse aggregate (grain size:100 / 150 mm) with a distribution layer above (grain size: 32 / 63 mm). This structure can bear a load of 45MN/m² when compacted. Nevertheless, a hollow space of approx. 30 % remains here.

For this purpose, a layer of coarse-grained gravel and finer, water-retaining material is laid beneath the paved surfaces in the road space.

In order to create suitable conditions (air, water, nutrients) for the roots of urban trees, fine substrate (silt, sand) with fertilizer, compost and coal components is slurried into the coarse material (here the retention space is reduced from 30 % to approx. 10 %). The different pore sizes of this substrate cause the "sponge effect": the sand portions are responsible for the air balance, the silt portions for the water balance. The nutrient supply is ensured by fertilizer (short-term), compost (medium-term) and biochar (long-term).

The trees stand in their grids as usual, yet have direct contact with the gravel layers in the substructure and can push their roots through them.

Rainwater can also run off directly into the tree planter or, via inlet shafts and drainage facilities, into the gravel layer of the urban "sponge" structures. It is thus available to the tree in sufficient quantities and over a correspondingly longer period of time.

However, the rainwater should not be heavily pre-contaminated (see Austrian Water and Waste Management Association OWAV – Rule sheet 45 Surface drainage by percolation into the ground). Water draining from heavily trafficked roads is not suitable for these purposes. There are, however, enough other, more appropriate areas in the road space, such as footpaths and cycle paths or squares and pedestrian zones.

The road must be redefined and seen as a multifunctional structure and no longer just a technical one for transport. The road must be designed in such a way that it provides the vegetation with sufficient living space. However, this can only happen underground. An additional advantage is that water can seep down through a wide variety of channels, e.g. through sewer manholes, rain gardens, tree planters, permeable paving, etc. Such structural drainage elements allow for additional design options in public spaces, provided that the conditions resulting from the requirements of the various uses also allow this. In any case, they are an essential prerequisite for the permanent preservation of large trees in the streetscape.

4.4 Green roofs: considerable potential in multiple respects

The total roof area in Vienna is about 5,420 ha, of which 1,070 ha have a 0-to-5-degree inclination and 750 ha have a 5-to-20-degree inclination. The City of Vienna has recorded the entire roof landscape in a green roof potential register. Flat roofs with an inclination of up to five degrees are very well suited for intensive and extensive green roof use, while flat roofs with an inclination of up to 20 degrees for extensive green roof use. The minimum area for a green roof is 5 square meters and since the data is purely based on surveying technology, constructional factors such as the condition and statics of a roof cannot be recorded in the cadaster. This requires a separate technical examination on site.

Green roof areas can make a significant contribution to sustainable rainwater management by retaining rainwater and minimizing peak rainfall runoff. In addition, energy cost savings can be achieved by improving heat and cold protection and even by improving the microclimate.

In this context, the potential of green roofs on business and industrial buildings in the outer districts of the city must also be emphasized. This is also where the largest roof areas with the potential for greening are located, e.g. the 64,295 m² gravel roof of a DIY store in Donaustadt, or the central workshop of Wiener Linien (39,363 m²) in Simmering.

In general, the green roof potential is highest in the outer districts due to the urban expansion and development taking place there, caused by an increasing number of new residential buildings, which almost always have a flat roof construction.

Extensive green roofs are an ecological, easy-care alternative to conventional surface coverings such as gravel. They are characterized by a low construction height and plant communities that naturally cope well with the site conditions on roofs (sun, wind, drought, etc.). These roofs are extremely low-maintenance. Usually one to two maintenance cycles per year are sufficient. This type of roof greening is also suitable for sloping roofs.

Depending on the desired properties, such as load, evaporation capacity, retention capacity etc., the following key technical data result:

- Structural height from 10 to 20 cm
- Weight, waterlogged, from 90 to 250 kg/m²
- Water retention volume of 25 to over 60 l/m²

Intensive roof greening corresponds to the structure of a garden on a roof. Such roofs are usually multifunctional and accessible. Intensive greening requires a higher system structure, which is associated with a significantly higher load. Care and maintenance must be carried out regularly, as with any well-kept garden, and depends on the design and the plants selected. Depending on the thickness of the layer, almost all plants can be used (e.g. lawns, perennials, shrubs and trees), including other design measures (e.g. ponds, pergolas and terraces).

Range of the basic technical data:

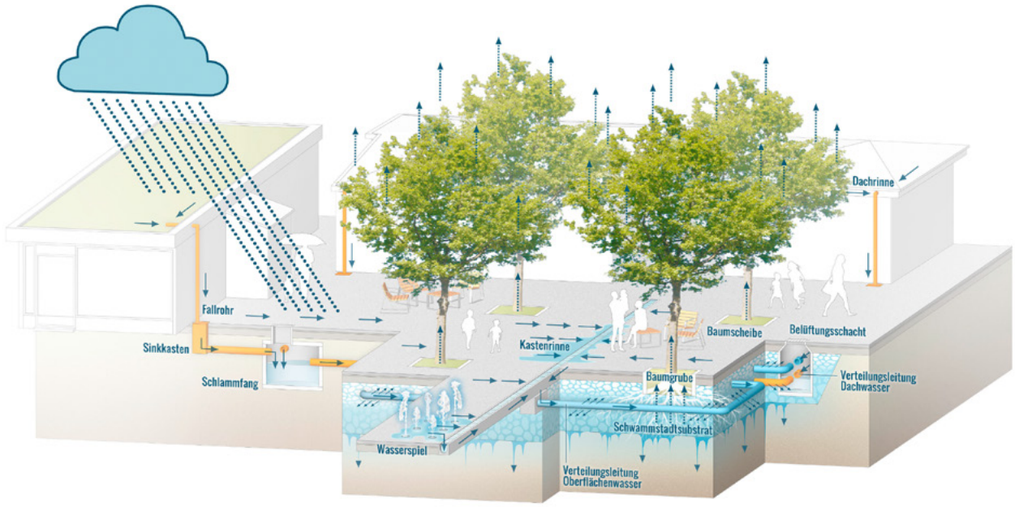
- Structural height from 15 to 200 cm
- Weight, waterlogged, from 200 to 3,000 kg/m²
- Water retention volume from 25 to over 150 l/m²

As the roof landscape of the City of Vienna is the basis for both the green roof potential register and the solar potential register[10], it appears at first glance that these different uses of roofs are in competition with each other.

In the inner districts, however, the green roof potential is quite low (7.3 to 19.6 %)[11] in relation to the total roof area in the district, due to the steeper roofs. The steeper roofs, however, are very well suited for photovoltaic and/or solar thermal systems. In addition, restrictions such as shading or an unfavorable orientation do not apply to green roofs, which further reduces the competitive factor.

In the case of flat roof pitches with a sufficiently large surface area, as is often the case in the outer districts, it is possible to combine a green roof with photovoltaics. Due to the cooling effect of the green roof on the PV panels, their yield is increased, creating a synergetic effect.

For larger flat roofs, e.g. on business and industrial buildings, even an installation without roof penetration is possible: the greening structure also serves as a necessary load for the wind suction protection of the solar system, which makes roof penetrations superfluous and also prevents high point loads.



The Sponge City, © DI Karl Grimm

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www.wien.gv.at/stadtentwicklung/stadtvermessung/geodaten/solar

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www.wien.gv.at/kontakte/ma22/studien/pdf/dachbegruenungspotenzial.pdf

On a pan-European level, land use by sealing has reached a significant scale. Economic growth and land consumption are strongly linked throughout Europe. The EU's annual land consumption of around 1,000 km² is roughly equivalent to the area of Berlin. New sustainable approaches for settlement and commercial development without additional land consumption are therefore necessary. In many European countries this is increasingly being taken into account, as the interrupted natural water cycle has an extremely negative effect on settlement areas, which is further intensified by climate change.

For example, the city of Hamburg was the first major German city to develop a comprehensive green roof strategy. This is part of sustainable urban development. The ambitious goal is to green at least 70 % of both new buildings and suitable flat or flat-sloped roofs to be renovated. A total of 100 hectares of roof area are to be planted in the urban area, thus bringing into focus the resource "roofs", which has not been the focus of attention up to now, and considering and developing its contribution to quality of life and attractiveness. In this way, 20 % of the green roof area will be usable as an open space for residents or employees. The plan is for green roofs to achieve an average rainwater retention of 60 %.

Hamburg's green roof strategy is scientifically supported by HafenCity University. In addition to providing support in terms of Submission, the scientists are collecting measurement data on water retention and thus on the effectiveness of green roofs in terms of water management. They are investigating how green roofs can be optimized for rainwater retention, especially during heavy rainfall, and whether climate indicators can be determined for the benefit to urban climate of different areas. Other cities can then use these data for their own climate impact adaptation measures.

The green roof strategy has three levels of action:

○ Action level 1: "Funding":
Funding green roofs by means of a funding program for new buildings, the renovation of existing buildings, and the special rewarding of intensive roof greening when determining rainwater drainage fees.

○ Action level 2: "Dialogue":
Communicating the green roof strategy to the public, externally to building owners and architects, internally to the authorities; communicating advantages and good examples.

○ Action level 3: "Demands":
Stronger control of roof greening through the consistent use of available legal instruments, such as the Building Code, the Nature Conservation Act, the Hamburg Building Regulations and a green roof ordinance.

Hamburg's green roof strategy is an excellent example of the concept of a "Sponge City". The aim is for as many vegetation-covered roofs as possible to ensure that rainwater drains off more slowly. In Berlin, in the Adlershof settlement area in Treptow-Köpenick without drainage, rainwater is collected decentrally from plots, squares and streets in lawn recesses, and seeps away. The water is thereby purified through the soil passages and subsequently adds to the groundwater. This measure relieves the burden on the sewage system and serves as a flood prevention measure.

The State of Berlin and Berliner Wasserbetriebe have jointly founded the Berlin Rainwater Agency. It is located at the water utilities office and is intended to support the administrators, planners and citizens in implementing decentralized solutions for a new way of handling rainwater, as the expansion possibilities of the central systems are limited.

In southeastern Berlin, one can already see what this could look like in the future throughout the city. During the construction of the furniture stores and the sports store on Schnellerstrasse, a huge seepage basin, around 200 meters long and one meter deep, has been installed between the parking lot and the street. It has a capacity of 1,000 cubic meters of water, which slowly seeps away underground after a heavy rainfall. Similar seepage troughs can be found on the streets of the Adlershof science park. The water from the main streets there is fed into a biological filter basin on Wegedornstrasse and, after purification, is led into the Teltow Canal. The two filter basins, each 6000 square meters in size, can treat around 300,000 cubic meters of rainwater per year.

In order to effectively counter the effects of cloudbursts, the city of Copenhagen developed a "cloudburst program" as early as 2012, which is to some extent an offshoot of the Copenhagen Climate Adaptation Plan. The plan contains the priorities and measures recommended for climate adaptation, including the management of extreme precipitation. In the course of an overall assessment, the costs of adaptation measures were compared to the costs of consequential damages with and without the mentioned measures. The pragmatic approach to the problem is interesting: the chosen combined solution consists of expanding the sewer network

and about 300 surface projects with a focus on water retention and drainage.

Since intensive precipitation events occur quite frequently in Copenhagen and cause great damage, a strategic urban flood plan was also drawn up. In this plan, elements of the urban space, such as parks, squares and streets are to be redesigned in such a way that they can function as retention areas in an emergency – for example as "Retention Boulevard", part of the set of the so-called "Cloudburst Toolbox".[12]

The following example illustrates the practical implementation of such a plan: The combined climate adaptation and urban space project Bryggervangen and Skt. Kjelds Plads is the largest and most environmentally friendly project to date for adapting to heavy rainfall events in Copenhagen. The project involved the transformation of a heavily crowded urban space into a new public green space. Approximately 9,000 m² of asphalt was unsealed and renatured and nearly 600 new trees were planted. The so-called "first flush method" is used here, whereby the initial dirty rainwater is drained from the roadway into the sewage system, but the subsequent clean water (second flush) is directed to the green areas.

The 586 new trees, which form the basis of a network of green rain gardens, most of which were created in soakaway ponds, play a central role in rainwater management. During more intensive rainfall or heavy rainfall, the rainwater is drained into the rain gardens and slowly seeps away on site. The portion that cannot be absorbed by the seepage basins is transferred to the port of Copenhagen via the so-called "cloudburst pipeline".

In contrast to those regions of Europe where the surplus of rainwater becomes a problem, in the southern regions the storage of rainwater to bridge dry phases with a sometimes acute water shortage is currently being discussed.

Many urban areas in southern Europe suffer from water scarcity, although paradoxically a local source of water – such as rainwater – has tended to be treated as a risk rather than a valuable resource. Rainwater and its use could play a central role in increasing the security of the water supply. A rethinking process has already begun here that considers rainwater as a local resource: harvested rainwater can be used to water gardens, flush toilets and wash clothes.

Sant Cugat del Vallès in Spain aims to save and store water and requires the installation of water-saving devices such as water pressure regulators or dual flush toilets in new buildings, as well as the (re)use of local water sources such as rainwater, gray water and water from swimming pools. Rainwater tanks and the installation of rainwater harvesting systems are mandatory. Grants have been offered to households that are not affected by this regulation but show an interest in installing such systems on a voluntary basis. Thus, an increased awareness of sustainable system solutions could be linked to an economic interest, as the result is lower fees for purchasing water from the mains, which can thus be relieved of a considerable burden.

Sant Cugat del Vallès was the first Spanish municipality to issue such a decree. In the meantime, several municipalities have followed this example and legal instruments have been created to support this process at a regional level.

To date, such ordinances have been issued in municipalities with just under 1.5 million inhabitants – including 32 in the metropolitan region of Barcelona. The most innovative and outstanding feature of these local water regulations is the installation of small water systems for harvesting rainwater and reusing gray water locally.

In summary, the discharge of unused rainwater from sealed surfaces, be it roofs or traffic areas, is a waste of valuable resources. An excess supply of rainwater can be easily recycled using the Sponge City principle. This is why several megacities in Europe have made this principle an integral part of their Smart City concept. The Sponge City principle has a future: megacities in China have also developed programs in this area, with triple-digit billions of euros being made available for these projects. In this context, cooperation agreements with partners in Europe have also been concluded.[13]

The other aspect of rainwater harvesting concerns water scarcity due to droughts, which, due to climate change, are now also being observed in Central Europe. Here, too, there are proven solutions. Decisive for the success of all these measures is the legal framework, which is incorporated into building regulations, development plans and the like. This is the only way to avoid expensive consequential damage and at the same time significantly improve the quality of life in settlement areas.

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www.nclurbandesign.org/2019/12/living-with-floods-water-management-and-the-ecological-urban-park

13
CEWP Water and Urbanisation – China-EU Cooperation on Sponge Cities:
www.tuas.fi/en/research-and-development/projects/cewp-water-and-urbanisation-china-eu-cooperation-s/

Water reservoir Simmering, © City of Vienna

6. The Viennese context

The challenge of “rainwater in the city” is being taken up at various levels in Vienna. The strategic documents of the Urban Development Plan and the Smart City Framework Strategy show the basic approach and indicate the scope for concrete measures. The paradigm shift is also clear, because in the past it was necessary to get rainwater into the sewage system as quickly as possible, but now the rainwater is supposed to seep away and evaporate on site if possible.

The legal level comes into play when there are desirable and undesirable effects and issues of liability. For example, in the case of innovative projects, the question of what water not discharged into the sewage system can be used for is important.

In principle, the approval of Wien Kanal is required for the discharge of rainwater into the sewage system for construction projects. Proof is required for precipitation quantities that are not discharged into the sewage system (Section 63 of the Viennese Building Code, Sewer System and Discharge Fees Act).

Responsibility for projects concerning the so-called “green” and “blue infrastructure” in the road sector lies at the district level. This means that the districts must also provide the financing. Funding for this purpose is available from both the City of Vienna[14] and the Austrian federal government.[15]

However, a lot of things call for personal initiative. Many inner courtyards are areas that cannot be built on and landscaped, but can still be transformed into small, livable oases. Funding is available for unsealing and greening.

In subsidized Viennese housing, climate change adaptation and rainwater management are making an essential contribution towards the two supporting pillars of ecology and social welfare.

At the “interface between subsidized housing and urban space”, attempts have been made in recent years and decades to implement higher-level urban development, traffic-related and open space planning objectives at the level of construction projects by means of quality specifications and procedures. Urban development contracts represent a targeted instrument for funding the district-related benefits of new districts, whereby requirements can also be set for green buildings and rainwater management.[16]

Such projects play an essential role in the implementation of rainwater management, ranging from the European dimension to small-scale initiatives that emerge as part of a local agenda or are supported by local area services. Within the framework of the EU project “Smarter Together”, for example, the installation of a retention basin for rainwater storage for irrigating a green roof and for cooling was initiated for a school on Enkplatz in Vienna Simmering.[17]

In local agenda groups such as “Draussen in Neubau” in the seventh district, people are actively involved in protecting urban trees.[18]

14 www.wien.gv.at/umwelt/cooleswien/foerderungen-bezirke.html

15 gruenstattgrau.at/urban-greening/foerderungen

16 www.wohnbauforschung.at/index.php?inc=download&id=5948

17 www.smartertogether.at/umfassende-sanierung-der-nms-enkplatz-im-plan

18 www.agendaneubau.at/blog-detail/ein-leben-ohne-baeume-ist-nicht-vorstellbar.html

7. Projects inspired by the “Rainwater in the City” challenge

The Vienna Business Agency’s Co-Creation Lab supports companies and public organizations that are looking for innovative solutions to a business challenge or need new impulses from other companies and research institutions.
In this particular case, the “Rainwater in the City” challenge was submitted by the Competence Center for Green and Environmental Infrastructure, Environment of the City of Vienna’s Chief Executive Office in March 2019.

The City of Vienna and Wien Kanal are seeking solutions for sustainable drainage and the use of rainwater in the city. The invitation to take part in a public co-creation challenge and submit solution ideas was accepted by 22 companies. At the business meeting on this topic in June 2019, the challenges were discussed in more detail and an opportunity for exchange was provided.

In September 2019, a hearing was held at which 21 proposals from 17 companies and research institutions were evaluated by a jury. In November, the results were presented and the prizes were awarded, with the distribution of € 15,000 in prize money.

The Co-Creation Lab Vienna is co-financed by the European Fund for Regional Development.

○ 1st prize: Decision Matrix

The winner was the student group ‘kollektiv regenwasser’(Andreas Berger, Marlies Macher, Pia Minixhofer and Oliver Weiss), who came together at the Institute for Engineering Biology and Landscape Architecture (BOKU). They were able to convince the jury with their decision matrix as an interactive web application for planners, building owners and interested parties for the purpose of quickly finding precise-fitting rainwater solutions adapted to building types and structures:

<u>Load-optimized retention irrigation – intensive</u>

- Rainwater retention, storage and distribution on the roof when high loads are possible
- Application area: roof, (façade), ground
- Rainwater tank: cistern
- System components: cistern, solar pump, solar panel, installation pipe, perforated trough with fleece coating
- Optional: Components for irrigation, mist and gray water systems, energy storage

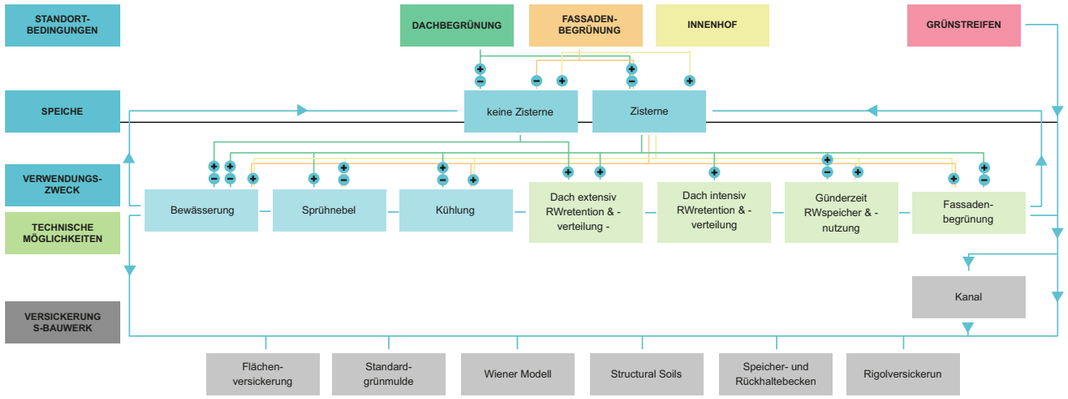
<u>Load-optimized retention irrigation – extensive</u>

- Rainwater retention & distribution on the roof when only low loads are possible
- Application area: roof
- Rainwater tank: optional
- System components: perforated trough with fleece coating
- Optional: cistern, solar pump, solar panel, installation pipe, components for irrigation, mist and gray water systems

<u>Cycle in Gründerzeit houses</u>

- Rainwater storage and utilization for old Gründerzeit houses (i.e. from the Wilhelminian era)
- Application area: roof, façade, ground
- Rainwater tank: cistern
- System components: components, cistern, solar pump, solar panel, installation pipe adapted to the respective façade greening system
- Optional: components for irrigation, mist and gray water systems, energy storage

ENTSCHEIDUNGSMATRIX



LEGEND

- Wasserfluss Dachbegrünung
- Wasserfluss
- Wasserfluss Innenhof
- Wasserflus
- Rückfluss
- Standortbedingung gegeben
- Standortbedingung nicht gegeben
- Fließrichtung

Decision Matrix, © Berger / Macher / Minixhofer / Weiss

○ 2nd prize: Local rainwater storage using artificial basins

2nd prize: Local rainwater storage using artificial basins
The second prize was awarded to Marc Frühmann and Stefan Savic from the study program Urban Renewable Energy System at FH Technikum Wien for the development of 4 models for local rainwater storage.

Through local storage of rainwater and targeted, sustainable use of this rainwater, it is possible to relieve the burden on the sewers and let excess rainwater seep away naturally. The rainwater is collected in artificial basins in the city and used to irrigate plants, which in turn cool down the environment in a natural way through the evaporation of water, thus preventing heat islands in the city. By means of the flexible design and layout of such rainwater basins, it should be possible to keep the costs low and to adapt the developed system to the respective requirements. Four possible varieties of such a system have been developed for this purpose:

First model – Standard version:

The standard model includes a 180m³ rainwater storage tank which can be embedded in the ground in pedestrian areas. This tank is secured by a bullet-proof glass pane. The superimposed structure creates shade and provides an area for cultivating green plants.

Second model – Hydroponic system:

In the second model, a hydroponic system provides irrigation for the plants. This system reduces plant care to a minimum, accelerates growth and uses space efficiently. The fertilization here is done by selected fish cultures, which are adapted to the environment and do not need algae to survive. The challenge here is the appropriate cleaning and filtering of the rainwater produced in order to create a suitable habitat for the fish, which in addition to fertilizing the plants also create an attraction in the city.

Third model – Hydroponic system with canopy:

The basic structure corresponds to that of the second model, with the addition of two canopies with further planting space. This results in increased shading capacity as well as a significantly higher evaporation capacity, which can prevent urban heat islands more effectively.

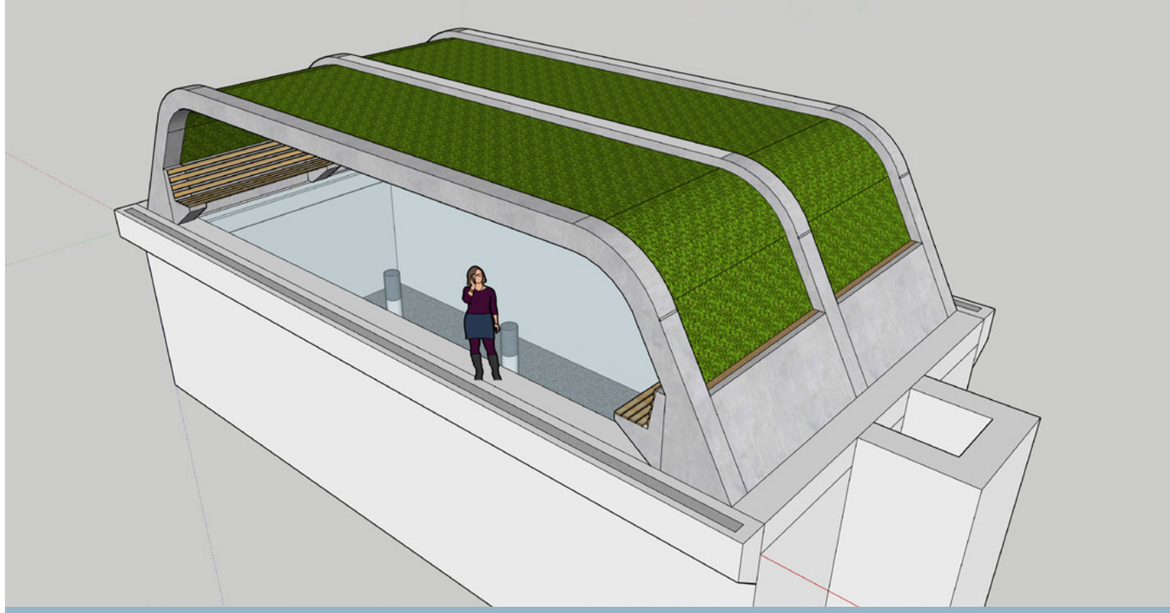
Fourth model – “City Haunt”:

In this model, the shaded room is also used for culinary purposes. This ensures that the existing company or the company leasing the place takes over the care and maintenance of the system. The aim is not only to provide a cooling service, but also to create an interesting meeting place. Operating costs can be reduced through revenues from the restaurant business.

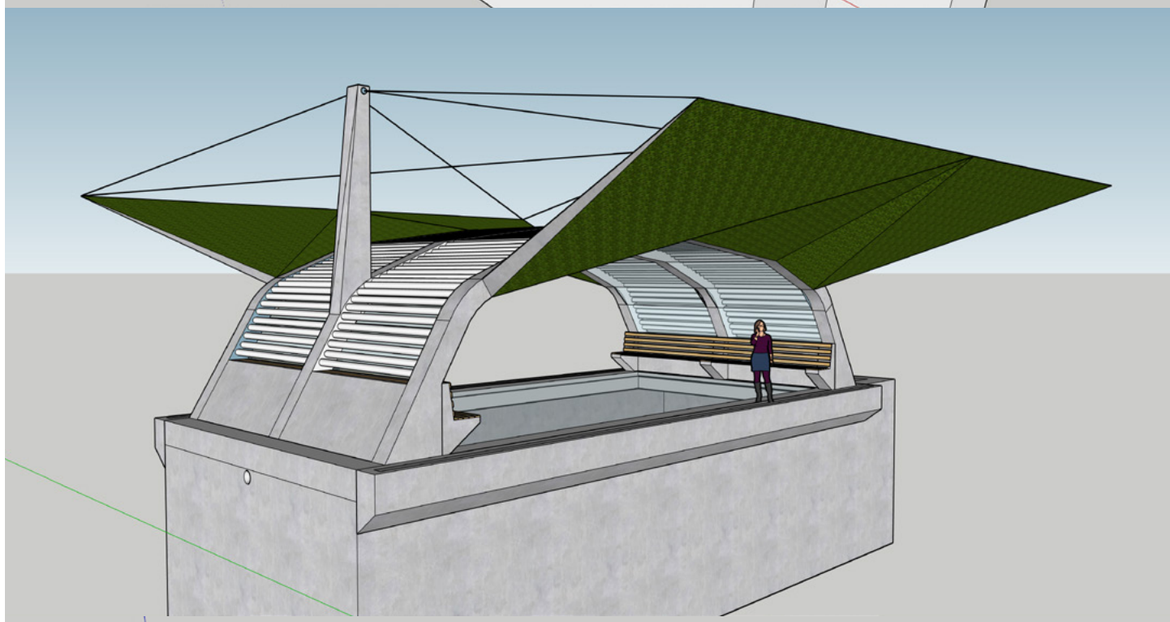
○ 3rd prize: Street Tree Planter

The third prize was awarded to the “Street Tree Planter” idea. A consortium consisting of companies (GEOplast Kunststofftechnik Ges.m.b.H, Green4cities GmbH, Weissenböck Baustoffwerk Gesellschaft m.b.H., IMG Innovation Management Group GmbH) and the Institute for Biological Engineering and Landscape Architecture (University of Natural Resources and Applied Life Sciences (BOKU)) developed a concept for the simpler, more cost-effective cultivation of urban trees in planters using rainwater for irrigation.

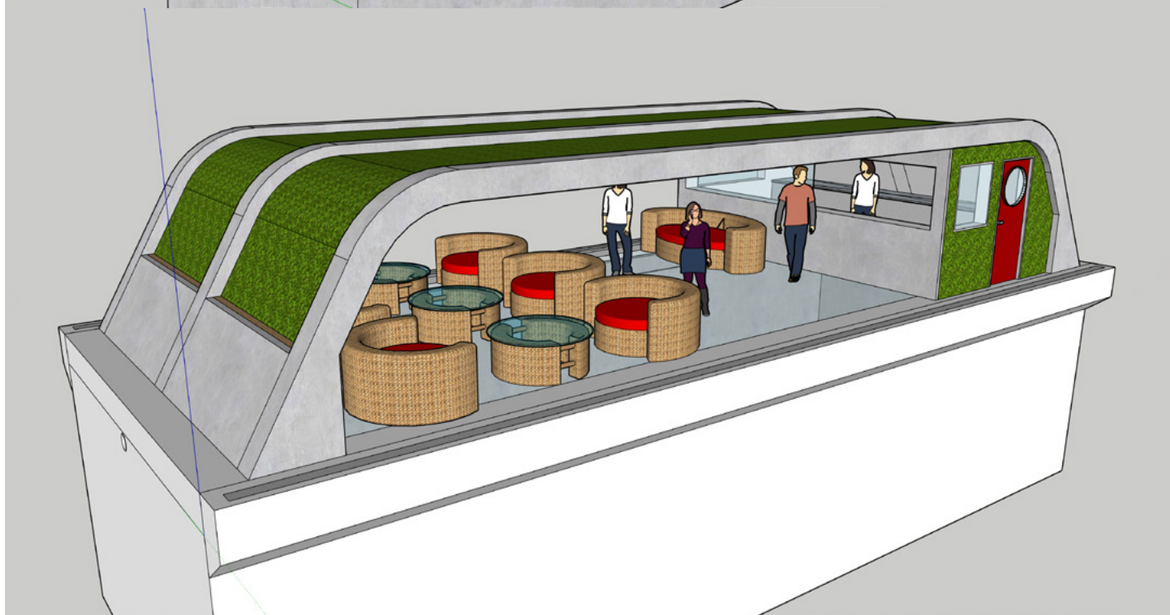
Street Tree Planter is a novel concept for creating a well-thought-out, cost-effective way to use urban trees as an effective measure for climate change adaptation in urban areas, using an even simpler and more broadly applicable method. The Street Tree Planter enables new locations for urban trees by creating sufficient root space while at the same time protecting existing pipe-bound infrastructures (sewage system, drinking water pipes, ...) from damage by tree roots. The concept also simplifies and accelerates the construction process, as the trees can be delivered to the construction site with the planting system. Thirdly, urban trees equipped with the Street Tree Planter also help to avoid peak flows into the sewage system as a result of heavy rainfall, as rainwater is stored locally in the Street Tree Planter and used for irrigating the urban tree.



Model: Standard version, © Frühmann/Savic



Model: Hydroponic system with canopy, © Frühmann/Savic



Model: City Haunt, © Frühmann/Savic

Submissions Co-Creation LAB

TEAM/COMPANY	DESCRIPTION/CONTENT
3:0 LANDSCHAFTSARCHITEKTUR 3:0 Landschafts- architektur Nestroyplatz 1/1 1020 Vienna www.3zu0.com DI Karl Grimm Mariengasse 13/2 1170 Vienna grimm.lojnik.net	The working group “Schwammstadt” (Sponge City) consists of two planning offices for landscape architecture and landscape planning. One goal of the working group is the funding and development of the “Sponge City principle for urban trees”. Karl Grimm landscape architects (DI Karl Grimm, engineering consultant for landscape architecture and landscape conservation): Aside from the usual open space planning tasks, the civil engineer’s office with four employees has been dedicated to rainwater management in settlement areas for over 10 years. ○ Submission: Sponge City principle for urban trees: Decentralized rainwater retention, evaporation and percolation to help adaptation to natural water cycles – Development of healthy, viable urban trees that are able to age – Evaporation and shade to positively influence the urban microclimate – Enahanced well-being of city dwellers and city users through visible and effective urban greenery – Contribution to biodiversity in the city.
ALCHEMIA-NOVA GMBH (ALCN) Baumgartenstrasse 93 1140 Vienna www.alchemia-nova.net	ALCN is a non-university research company based in Vienna (14th district). The main focus is on recycling management with nature-based solutions and bio-based industry. The focus is not only on the decontamination of wastewater, soil, landfills and air, but also on the recovery of the substances they contain for further use. ALCN is involved in a number of international and national research projects, is a Cradle-to-Cradle© partner and also offers its services to private companies. ○ Submission: LCN develops green panels for building façades, which can be used as a vertically constructed wet biotope for purifying gray water and urban rainwater. The modules are dimensioned according to the amount of wastewater and rainwater. The plants used are adapted to the region, perennial and frost hardy. Cleaning is carried out by microorganisms that establish themselves in the root space of the plants. Rainwater is collected via existing structures of residential and office buildings (gutters), stored in buffer tanks and finally used for irrigation of the greened modules. As sustainable mobility will dominate the city of Vienna of the future, parking spaces will become vacant in multi-storey parking lots and garages. They provide the appropriate space and structural conditions for rainwater tanks. During the dry months, the green panels can be watered and fertilized using wastewater.

TEAM/COMPANY	DESCRIPTION/CONTENT
BAUCHPLAN).(Endresstrasse 18 1230 Vienna www.bauchplan.at	bauchplan).(develops identities. bauchplan) has been designing places at the interface between space and society for over 18 years: places at the interface between space and society that are climate-friendly and characterized by sociological sustainability. The interdisciplinary team approaches new tasks in a prototypical way with the aim of creating multi-layered, enhanced spaces of possibility in open design processes. ○ Submission: The relocation of the long-distance traffic to the central railway station offers the unique opportunity to reinterpret the infrastructure corridor in the middle of the 15th district (which has been difficult to negotiate for decades) as the Westpark and to re-connect it to the surrounding neighborhoods. A large-scale rainwater management system in the west of Vienna is to be initiated through pilot projects. Reclaimed infrastructure areas will be converted into near-natural retention areas into which surface water will be channeled. In the Westpark, wastewater and surface water will be decentrally separated and reprocessed in a space and resource-saving manner. In contrast to the usual practice in many places, rainwater management is networked and designed on a large scale and is based on innovative synergies with other urban development projects.
DR. RAMESH KUMAR BISWAS GMBH Mommsengasse 21/6 1040 Vienna www.rameshbiswas.com	Multicultural urban planning/spatial planning/resilient city consulting, project leadership, project management, monitoring with a holistic approach. Projects with Green Building/Waste/Water/Energy/Mobility in different regions of Europe and Asia. Several consulting and study assignments for the City of Vienna and the Austrian federal government. Recognized worldwide as a Smart City expert, keynotes at universities, conferences, World Bank/IWF Annual Conference 2018, etc. ○ Submission 1: COOL ICELAND INSTEAD OF “URBAN HEAT ISLANDS”: A concept for better rainwater management in the city, which aims at the transformation of former parking lots and concreted residual areas into OASES. Rainwater is filtered via attractive silver inverted hi-tech “UMBRELLAS” and discharged into a leak-proof retention water tank, which is built on existing sealed residual areas, without expensive excavation work. Rainwater is also filtered through porous pavements/stone carpets and seeps into the water tank over the entire area of the site. On hot and dry days the water is pumped up again using solar energy (the Umbrellas are covered with photovoltaic foils), then sterilized with UV light and mixed with natural flower-scented oils and then periodically sprayed through nozzles on the edges of the “Umbrellas” in a mist over the square. ○ Submission 2: COLORED POINT: From recycled plastic mixed with resin an extremely strong plastic is produced, which is even suitable for pad foundations. This material can be used to produce hollow giant “nails” with grids and slots. These can be inserted point by point – for example in a grid – into sealed surfaces. This colorful grid of dots revitalizes desolate concrete/asphalt surfaces. 20–30 percent of the rainwater can thus be fed directly into the ground below. The technical aspects were discussed and clarified with water experts from AIT Austrian Institute of Technology, University of Natural Resources and Applied Life Sciences (BOKU), Vienna University of Technology (TU) and M.U.T. Anlagenbau.

TEAM/COMPANY	DESCRIPTION/CONTENT
HELIOFLOAT GMBH Industriestrasse 18 4800 Attnang Puchheim www.heliofloat.com	HELIOFLOAT GmbH is a spin-off of the Vienna University of Technology and was founded to implement and market special patents. These patents are the results of an interdisciplinary study on the suitability of platforms hovering on water on stationary air cushions. These platforms are seaworthy, do not sway even in waves of up to 12m in height and their hovering height above water can be adjusted to varying or constant heights above water, as required. Two prototypes with 50m² and 150m² platform surfaces are currently under construction in Italy. ○ Submission 1: HELIOFLOAT proposes to build floating city districts on HELIOFLOAT platforms in Vienna. The buildings in these districts will be built on the HELIOFLOAT platforms. The platform with the buildings will float on stationary air cushions above water. This water is to be collected in storage basins that are yet to be built and will come mainly from rainwater or Danube water surpluses. The aim is to achieve a large-volume, rapid collection of water surpluses without using up natural areas or building land, or digging holes, and the rapid availability of the collected water. ○ Submission 2: The proposal is to place tanks similar to advertising pillars, which function as advertising space on the outside, with a diameter of 2m, height of 4m, capacity of 10m³, for rainwater or excess water in the hot spots and to use the collected rainwater or excess water similar to the commercially available evaporative coolers. These evaporative coolers are to be installed in streets at intervals of about 50m. 1m³ of water provides about 650 kWh cooling energy through evaporation. To increase the storage capacity, tanks made of welded flexible tarpaulins in unused basement compartments can be used for rainwater collection. This can also be used for roof garden irrigation.
DDI DR. TECHN. JOHANNES LEIMGRUBER, BSC www.oestap.at/team	In the course of his work at the Institute for Urban Water Management and Landscape Water Engineering at the Graz University of Technology, Dr. Johannes Leimgruber has intensively investigated topics of near-natural precipitation water management (NWB). The main focus was on the use of hydrodynamic simulations as a planning and optimization tool. Most of the results have been incorporated into his doctoral thesis. ○ Submission: Rainwater management measures mitigate the adverse effects of ongoing urbanization such as urban heat islands, flooding and reduced biodiversity. Hydrodynamic long-term simulations are best suited to assess the impact of rainwater management measures on the water balance. The overall goal is to achieve an approximation to the natural water balance. The submitted proposal is based on the holistic and model-based method for the evaluation and selection of rainwater management strategies described in Leimgruber et al., 2019 and in the PhD thesis. In addition to the overall water balance, economic aspects such as life cycle costs and land consumption are also taken into consideration. The three criteria mentioned above are summarized with the help of a developed characteristic value, which enables a simple and clear evaluation of the rainwater management measures under consideration.

TEAM/COMPANY	DESCRIPTION/CONTENT
OPTIGRÜN INTERNATIONAL AG Landstrasser Hauptstrasse 71/2 1030 Vienna www.optigruen.at	Optigrün international AG is one of the leading suppliers of roof and building greening in Europe with 6 branches in 6 countries and about 120 partner companies. The company attaches great importance to meeting today’s environmental challenges in urban agglomerations with innovative, state-of-the-art solutions. These include retention roofs with a strong flow delay as well as static or dynamic throttle, which enable the sustainable use of rainwater and the mathematical dimensioning of retention areas on buildings. Since 2018, Optigrün has had its own research and development department with a focus on rainwater management, which is kept state-of-the-art in cooperation with research institutes and universities. ○ Submission 1: Meander elements 30 and 60. The special feature of the meander elements is the strong flow delay, which provides flood protection by using a very specific type of drainage plate. With the meander element 60, the water flows from one of the numerous chambers into the other in a loop like a meandering stream, in imitation of nature. The flow distance is thereby extended by a factor of 13, the water is permanently retained and thus increases the evaporation capacity of the vegetation. The meander element 30 has only a temporary water reservoir, but here too the flow distance is extremely long: In the case of the two-square-meter meander element 30, the water has to travel a distance of up to 46 meters. In addition, there is only a narrow gap at the end of the flow section of each element from which the water also flows out at a reduced rate. ○ Submission 2: The Smart Flow Control is an automatically controlled discharge throttle, depending on the weather, for use on retention roofs (green roofs with a flat rainwater reservoir). On the one hand, retained rainwater is available to vegetation for evaporation, which restores the natural water cycle and cools the urban environment, while on the other, it counteracts flooding by relieving the burden on the urban sewers. The intelligent control system drains rainwater, if necessary, BEFORE a rain event, to make room for the upcoming rain. At the same time, only exactly the right amount of retention volume is created to absorb the upcoming rainfall. Thus, the optimal amount of water is always retained on the roof. ○ Submission 3: The static throttle contains a bore hole which is made individually and accurately fitting for each roof based on calculations. If the bore hole is set high on the throttle, a lot of rainwater is accumulated in the retention space, which evaporates through the vegetation. A lower bore hole provides a high level of protection against flooding, as the retention space empties to the bore hole height, thus creating space for the next rain event. The speed of the water outflow can also be adjusted with the size of the borehole.

TEAM/COMPANY	DESCRIPTION/CONTENT
LACKNER VENTURES & CONSULTING GMBH Hofherr Schrantz Gasse 2 1210 Vienna www.drlackner.com	The company was founded in 2013 and currently has one employee. The focus is on bioplastics. They have developed and patented their own process for the production of the bioplastic PHB. In 2018 they received two awards (Energy Globe Award Vienna, Mercur Award). ○ Submission: The idea is to use nonwovens on roofs, in the ground and in retention basins as retention bodies for rainwater in order to evaporate the water on site. Special nonwovens can bind water (or even hydrocarbons), sometimes up to 18 times their own weight. They allow the slow release of water by evaporation. By incorporating the bioplastic PHB into the nonwovens, the nitrate load can be reduced at the same time. Furthermore, oil-binding fibers and activated carbon can be incorporated to bind pollutants.
RIOCOM AND VRVIS RIOCOM Handelskai 92 1200 Vienna riocom.at/kontakt VRVis Zentrum für Virtual Reality und Visualisierung Forschungs-GmbH Donau-City-Strasse 11 1220 Vienna www.vrvis.at/ueber-uns/kontakt	RIOCOM is an engineering office for cultural technology and water management which was founded in 2001 by company owner Albert Schwingshandl and currently employs ten employees. The competence spectrum covers river renaturation, risk management, flood protection, disaster prevention and simulation. VRVis is Austria's leading research institution in the field of visual computing. The team consisting of more than 70 employees works on innovative application-oriented research and development projects. As a COMET competence center, the company and its partners from science, business and industry pursue the goal of building a bridge between research and practice. ○ Submission: Software solution for numerical simulation and visual analysis in rainwater management: with the help of the worldwide novel software Visdom, the city is reconstructed in a detailed terrain and building model. Any rainfall event can be applied to this model. In the computer simulation, virtually every raindrop can be tracked on its way through the city. The model contains all parameters that are decisive for the calculation of the runoff or retention processes in the rainwater cycle. The basis is a high-resolution 3-D terrain model based on laser scan data, into which the stock of buildings and the underground drainage system are integrated. Various measures can be implemented and evaluated quickly and easily in the existing building model. The effectiveness of different combinations of measures can be tested for any type and size of area in order to develop a cost-benefit-optimized solution strategy.

TEAM/COMPANY	DESCRIPTION/CONTENT
SPIRIT DESIGN – INNOVATION AND BRAND GMBH Wattmanngasse 8 1130 Vienna www.spiritdesign.com/contact	Spirit Design is an internationally renowned innovation and design consultancy based in Vienna and Rio de Janeiro, specializing in innovation and branding. Over the past 27 years, the sustainable, systemic consulting approach has resulted in the establishment of a base of well-known clients and references in the fields of smart mobility, renewable energy, Industry 4.0, digitization & IOT as well as smart cities and has won many awards. Besides the national and international client business with innovation and brand development, Spirit Design also specializes in start-up consulting, frugal innovation, European (Horizon 2020) and national research projects. ○ Submission: Spirit Design Smart City consulting approach: Individual ideas for measures will not solve the present complex problem. Therefore Spirit Design offers to emcee the idea contest with our Smart City consulting process. Together with your and our network of experts we will develop a holistic innovation strategy with an action plan to solve the problem. As the leader of a competent and diverse consortium, Spirit Design offers to support the business agency or the clients of the challenge in the following steps: ● Definition of the objectives and strategic framework and evaluation criteria with the responsible persons in the city planning department ● Thematic clustering of ideas, support in evaluation ● Consolidation of clusters and development of integrated, holistic concepts with a multisolving approach ● Visual design of the concepts ● Development of a holistic innovation strategy aligned with the urban development plan, Smart City Strategy and defined goals ● Support in implementing and developing communication measures

TEAM/COMPANY	DESCRIPTION/CONTENT
INNSBRUCK LEOPOLD FRANZENS UNIVERSITY Arbeitsbereich Umwelttechnik Technikerstrasse 13 6020 Innsbruck www.uibk.ac.at/umwelttechnik	The Department of Environmental Engineering (IUT) is part of the largest scientific institution in Western Austria, the University of Innsbruck. The IUT is part of the Institute for Infrastructure at the Department of Technical Sciences. They are actively working in the research fields of urban water management and waste treatment and resource management, and operate a laboratory for planning and executing measurement campaigns and deal with environmental engineering issues. A main focus is the investigation of regional (alpine) problems with the aim of developing sustainable technical solutions. ○ Submission: Interaction between the site and the drainage process. A special focus is placed on multifunctionality and several objectives are combined: relief of urban drainage systems, improvement of the urban microclimate and reduction of heat islands as measures for adapting to the effects of climate change. Through the integration of decentralized drainage systems, rainwater is treated directly on site and, through the processes of seepage, evapotranspiration and storage of water, enables so-called “multi-benefits” to be generated.
LITE-SOIL GMBH Neustiftgasse 94/23 1070 Vienna lite-soil.com	Lite-Soil GmbH was founded three and a half years ago and produces internationally successful water reservoirs close to the roots, aeration systems and underground irrigation systems based on geotextiles for sustainable plant growth in gardening, landscaping and urban greening. The water and cost-saving products for e.g. tree plantings, plant troughs, slope greening, lawns or sports fields are available in Austria through the company Austrosaat (www.austrosaat.at). ○ Submission: Viennese mushroom: There is a wide variety of storage tanks for rainwater. Most of them are, however, “raingarden-like” on the surface, tank types or cisterns at the root depth of mature trees (sponge city) or even below (tree ditch).The solution proposed in between is aimed at achieving underground yet near-surface area storage, located for example under sidewalks, cycle paths or tree planters. In addition to the intermediate storage of rainwater, it can also irrigate young trees in the long term by means of throttled gravity flow, thus saving expensive manual irrigation. In addition, it is relatively simple and inexpensive to implement.

TEAM/COMPANY	DESCRIPTION/CONTENT
DI MARTINA WORAHNIK ENGINEERING OFFICE FOR CULTURAL TECHNOLOGY AND WATER MANAGEMENT AND PIPELIFE AUSTRIA GMBH & CO KG DI Martina Worahnik Wiener Neustädterstr. 82 2551 Enzesfeld-Lindabrunn www.grundwasser-worahnik.at Pipelife Austria GmbH & Co KG IZ NÖ-Süd, Strasse 1, Objekt 27 2355 Wr. Neudorf www.pipelife.at	The engineering office Worahnik specializes in infiltration, rainwater utilization and groundwater issues. Main fields of work are the planning and design of infiltration concepts for commercial enterprises, rainwater utilization in the living area as well as hydrogeological work such as expertise in water/water heat pumps or preservation of evidence in construction projects. Pipelife Austria is the leading plastic pipe manufacturer in Austria. The company’s main area of expertise is the development, production and sale of high-quality pipe systems. ○ Submission: Selected building typology: Gründerzeit city – selected stage of development: finished product: The novelty of this solution is the multifunctional use of multi-purpose strips, road surfaces and tracks. By unsealing these areas, the natural rainwater cycle is reactivated, groundwater recharge occurs on site and thus also has a positive influence on the microclimate. A further novelty: the targeted short-term damming up of suitable, unsealed surfaces in the course of heavy rainfall events. In this way, unhindered flooding by surface water, e.g. at the grass level, can be contained. As only part of the surface is sealed due to the modular system used, the water can not only flow off via gullies but also seep away over large areas.
ZENEBIO GMBH Preysinggasse 19 1150 Vienna zenebio.at	Zenebio GmbH was founded in 2015 by four partners after a long period of joint research. Zenebio is an acronym and stands for “Zentrum für nachhaltige Entwässerungssysteme auf biologischer Basis” (en.: Center for Sustainable Drainage Systems on a Biological Basis). The aim of Zenebio is to create new and innovative nature-based solutions for sustainable cities in the field of decentralized rainwater management with partners from all relevant disciplines (universities, planners, industry, etc.). ○ Submission: One of the solutions developed, as also submitted to the Co-Creation Lab, is the DrainGarden® system. With this substrate based system, surface water from streets, parking areas and roofs is discharged into e.g. roadside greenery or green borders, quickly absorbed (comparable to a sponge), stored in a manner accessible to plants and released back into the ground in a cleaned state. Since the start of the implementation of this Austrian development in 2014, the functionality of the system has already been proven in more than 70 projects. A fundamental part of this system is the planting. In the green areas, the water reservoir is emptied by the evapotranspiration of the plants. The advantages of the system are the reduction of peak runoff during heavy rainfall events, relief of the sewage systems, cooling of the environment by transpiration, improvement of the microclimate, vital plants with reduced watering requirements and much more.

8.1 Sponge City neighborhood in the lakeside town of Aspern

In the neighborhood “Quartier am Seebogen” in the lakeside town of Aspern, the most extensive Sponge City project in Austria has been initiated. An entire urban quarter is being drained using the local infiltration principle of the next-level Sponge City. It also includes the planting of more than 330 new trees, which – once planted – will guarantee a minimum canopy cover of 20 percent within 10 years, which is an absolute innovation in Austria, but will be trendsetting for the future.

There are three types of street: The ring street (Sonnenallee), the neighborhood streets and the neighborhood paths. The Sonnenallee will be continued along the existing construction sections. The neighborhood streets consist of a multifunctional strip, a mixed traffic strip and a functional strip with planted seepage basins, loading zones, etc. The multifunctional strip is particularly noteworthy as it alternates between recreational areas with spreading trees, and play and opportunity areas along the way, which the residents of the neighborhood are to make their own. This open-use design enormously increases the quality of the streetscape. The neighborhood paths are also designated as meeting zones.

In concrete terms, four measures which have been developed and implemented in close cooperation with the clients (Wien 3420 Aspern Development AG & Municipal Department 28 – Road Management and Construction) deserve emphasis here:

- Future-oriented design:
Room to move for everyone, continuous accessibility, an above-average number of large-crowned trees, premium recreational areas in public spaces.

- Rainwater management:
Dual Seepage PLUS (a further development of the “Viennese System”: reduction of surface seepage areas and simultaneous increase of the underground retention volume) – for more room in the limited public space.

- Sponge City principle:
Rainwater retention in the porous subsoil, which also serves as a root space for the street trees, as a solution strategy for the increasing heavy rainfall events and improvement of the microclimate through increased evaporation.

- Integrative planning:
In order to implement as many new solutions as possible, the planning process has also been adapted. All specialist areas (landscape architecture, traffic planning, infrastructure, cultural technology, fire protection) work simultaneously and integratively – not, as is usually the case, one after the other. The result is a truly livable street space as a response to the ever more diverse and complex demands on public space.

The layer structure of the ground under the Sponge City or the underlying technical principle is very simple – see the explanations in chapter 5.

Street substructures made of large stones with spaces in between were quite common in the past, but over the past decades the ground has been compacted more and more, which was actually not necessary at all. The costs of a Sponge City substructure are basically manageable: when civil engineering work is due anyway, whether for sewers, pipes or the subway, the system is cost-neutral. Potentially higher construction costs for renovations are amortized through less maintenance for the trees, less strain on the street, sewer and sewage treatment plant and the cooling effect, which is important for the well-being and health of the city’s inhabitants.

Sponge City Aspern, © PID/Markus Wache

8.2 Rainwater management in the Biotope City Wienerberg

On the 5.4-hectare site of the former Coca-Cola premises on Triester Strasse, the Biotope City Wienerberg, which sees itself as a 21st-century garden city, has been under construction since autumn 2017. Here, there are around 1,000 apartments, common rooms, community gardens, commercial areas, children's and teenagers' playgrounds, a school, a kindergarten, an office building and a hotel. The buildings are close to completion or partly already in operation.

In the preparation phase, an urban planning quality catalog was developed for the Biotope City Wienerberg. This also includes the on-site use of precipitation water. This water is not discharged into the public sewer as usual, but is mainly used directly on site through utilization for green roofs and areas, plant troughs and tree pits. A substrate is used which stores the rainwater for an exceptionally long time and is thus available to the plants after the elapse of a certain period.

The portion that cannot be retained at the source, especially during heavy rainfall, nor absorbed by the soil and green roofs, is collected, pre-purified and fed directly into the Wienerberg Pond, taking advantage of the natural gradient.

8.3 Water circulation within the Süssenbrunner Strasse residential park

Rainwater as a means of mitigating the increasing summer heat. This is the idea behind the water cycle within the Süssenbrunner Strasse residential park. This successfully implemented project was thus awarded the Environmental Prize of the City of Vienna in 2017.

Cooling is achieved through a kind of biological air conditioning system: this begins with extensively greened flat roofs, so-called retention roofs, which store rainwater and release it with a time delay. Different layers on the roof serve as water storage. A layer of gravel with plants absorbs the water. Underneath is a storage plate shaped like an egg carton, which releases the water only very slowly. It then continues with raised beds that serve as retention basins, finally flows in open drainage channels either into the green seepage troughs or, via large grids in the lawn, into underground deep beds that allow the rainwater to seep away and evaporate. Finally, that portion of clean, filtered rainwater that cannot evaporate locally seeps into the groundwater and thus also ensures clean groundwater recharge.

Gutters have therefore been installed around the building in Süssenbrunner Strasse to channel the rainwater. What is striking is that, in contrast to the usual practice, the drainage of rainwater is deliberately kept on the surface to make the water cycle visible. The water is stored in collecting basins and troughs. The aim is for it to be kept in the residential complex as long as possible and, if possible, evaporate on the spot, which corresponds to the natural water cycle. This creates a microclimate that functions like a natural air conditioning system.

This rainwater system is an absolute innovation in Viennese housing construction. According to the Siedlungsunion, which built the residential park, no additional costs were incurred. The concept is intended to serve as a model for future housing projects – as, with more buildings, more and more heat will also be stored in the city.

These three examples show that sustainable rainwater management is highly effective in new construction and does not cause any significant additional costs. Due to the cooling effect that can be achieved on hot days, the actual temperature in the vicinity of buildings can be reduced by at least two to three degrees, which not only results in considerable savings with respect to cooling energy requirements, but also creates a microclimate that promotes well-being. The following example shows that the renaturation of partial areas can be realized with relatively little effort even in densely built-up areas.

8.4 Seepage and evaporation of street wastewater in Bruno Kreisky Park

In the Bruno Kreisky Park in Vienna's 5th district, a pilot project for the sustainable use of rainwater in the city was realized by the district administration. The aim was to test the feasibility of an evaporation or seepage basin for surface water in practice. An existing, 426 m² earth trough was used as a location and, in coordination with the district administration and the specialized services, it was determined that rainwater from sub-areas (approx. 620 m²) of the Rechte Wienzeile street could be fed into the seepage trough. This covers the drainage area of two existing inlet shafts.

Up until now, the rainwater from the footpath and cycle path has been drained via the sewer all year round. Alternatively, the concept provides for a seasonally dependent, differentiated handling of the precipitation water. In the test facility, the outflowing rainwater is channeled into the seepage trough with an underground rainwater storage tank from April to October. Here, the soil stores part of the water. The plants and the surrounding trees in the park evaporate the water and thus improve the air quality as well as the cooling effect on hot summer days. The rest of the water seeps through the ground into the groundwater. In the process, it is purified by numerous microorganisms and contributes to groundwater recharge. However, the water contaminated with chloride by the winter road clearance service is still to be fed into the combined sewage system in the period from November to March.

This is to be achieved by enabling a changeover from summer to winter operation on the surface of the terrain near the intake shafts. This means e.g. closing the inlet grids with a cover. The changeover is carried out manually in spring and autumn.

Valuable experience was gained in this pilot plant, which will be incorporated into all future projects designed to bring the water balance closer to its natural state even in densely built-up urban areas.

The following example illustrates the functions that an area that was previously wasteland can fulfill simultaneously if careful planning allows for an optimal coordination of different categories of use.

8.5 University of Natural Resources and Applied Life Sciences (BOKU) – Triple use of the roof: open space, green space & PV power source

The production of renewable energy, retention of rainwater, absorption of CO_2, compensating for progressive surface sealing, offering space for recreation and extending the life of the roof membrane: the roof garden on a department building of the University of Natural Resources and Applied Life Sciences is achieving all this in the course of a three-year project development by ten partners. A multidisciplinary research team developed the system concept, which was installed at the test site on the BOKU roof terrace. This was intensively greened and creates a pleasant atmosphere of well-being. The pergola, consisting of semi-transparent glass-glass modules, provides shade and generates green power.

Although the wooden test facility at the BOKU does not yet correspond to the final architectural design, it is already possible to see and measure how the solution works. This previously little-used terrace has become an attractive place to relax or hold meetings, with a perceived temperature difference of three to five degrees. In the test garden, 5 tons of CO_2 are saved annually through photovoltaics alone. And that's without taking into account the CO_2-binding capacity of the plants and the soil.

A PV roof garden unit measures about 56 m² and can be multiplied as desired. It supplies about 5,500 kWh of green electricity per year – enough to supply one or two households. The project is intended to show what sustainable urban development can involve and at the same time initiate follow-up projects. This example, which is a successful combination of innovative approaches, also shows that uses that pursue different purposes are not necessarily in competition with each other, but even complement each other perfectly in terms of a highly efficient overall use of different resources.

BOKU roof garden with photovoltaic pergola, © Boku/Irene Zluwa

8.6 Quality leap in the neighborhood

A current example of sustainable rainwater management is the redesign of Johann-Nepomuk Vogl square, which forms the center of the Kreuzgassen quarter in Vienna's 18th district and was completed in September 2020. After an intensive planning and participation process, and supported by EU funding, the square was significantly upgraded and improved: a larger open space with street furniture and playground equipment was created, additional trees were planted and a water feature was installed for cooling down in hot weather. The drainage system is based on the Sponge City principle (also known as the "Stockholm system"): under the paved surface there is a layer of coarse-grained gravel as well as finer water-storing materials. All the surface water of the square, the water from the water feature as well as the roof water from the market stalls is now no longer channeled into the sewer but into this retention area and stored there. The plants, including six new trees, can thus be supplied with water over a longer period of time – which is particularly important during hot spells.

8.7 Vienna's first "sponge street"

The way in which the Sponge City principle influences new designs in public space is also illustrated by the transformation of Pelzgasse in the 15th district into Vienna's first "Cool Street Plus" (one of four permanent "cool streets"), completed in August 2020. Here, too, the redesign was developed in a participatory process. Here, for the first time, the Sponge City system has been applied in an inner-city district. A layer of coarse-grained gravel was applied in the street space, into which water and air-storing materials were slurried. The trees stand in their tree planters, yet have direct contact with the gravel layers and can root through them. The winter water, which is often contaminated with salt, and the first rinse water are discharged into the sewer, after which the rainwater is fed to the plants.

Pelzgasse street, between Felberstrasse and Goldschlagstrasse, was paved and constructed at the same level to clearly indicate the traffic-calmed, barrier-free area. A total of around 1,800 square meters of concrete block paving were laid. The street fittings include seating, a games table, a drinking fountain and a ground-level water feature. Five new tree plantings, a façade greening and areas for "gardening around the corner" were also implemented.

9. Outlook

and the effects on the health and well-being of the people living in the buildings are tremendous. All this shows the potential of sustainable rainwater management and the benefits it brings to urban life.

The developments over the past three decades have shown that the ultimate goal in dealing with rainwater in residential and industrial areas must be to largely restore the natural water cycle wherever possible. In the case of new buildings, the existing potential should be taken into account in the planning process and utilized as much as possible, especially since this does not result in additional costs (as the examples in the previous chapter show), while at the same time consequential costs (e.g. due to adjustments in the sewage network and damage in the event of flooding) can be avoided.

The Smart City concepts of metropolitan cities such as Vienna, Hamburg or Berlin have integrated this principle of renaturation or near-natural development into their mission statements and plans. Climate change, already measurable and noticeable, has admittedly aggravated the fundamental problem, which results from a high degree of soil sealing and the mass of buildings in the urban fabric. However, the storage and evaporation capacity of planted areas makes it possible to control both the overheating and the overburdening of the sewage system and the risk of flooding in urban areas.

The practical solutions presented by the examples shown in this report are largely based on proven, standardized system solutions that are also very powerful and, above all, scalable. Nevertheless, the scope for research and development is very great and offers many approaches for new ideas and groundbreaking innovations.

One very positive aspect that is certainly worthy of attention is the fact that these system solutions and measures are replacing standards in urban planning that have been usual for decades with new ones. These standards can subsequently ensure that planning can be adapted to new challenges. The quality of life is thus noticeably improved,

10. Services of the Vienna Business Agency

The objective of the Vienna Business Agency is the continuous development of international competitiveness by support-ing both Vienna-based companies and their innovative strengths, and the sustainable modernization of the city as a business location. To achieve this, the Agency provides free consultations to all entrepreneurs in Vienna on the topics of business creation, business location or expansion, business support and financing. Furthermore, networking contacts in the Viennese economy are also made available.

The Vienna Business Agency supports and helps busi-nesses complete their research and development projects with both individual consulting and monetary funding. Depending on requirements, they will receive information about sponsorships, financing opportunities, possible development partners, research service providers, or research infrastructure, according to their needs.

The Vienna Business Agency sees itself as a network of the Viennese Green Tech & Social Tech industry and supports businesses with consultations, as well with distribution and networking among themselves. Events and workshops on topics from the sustainability sector are held regularly.

Additionally, the Vienna Business Agency helps with company relocations or internationalization services. Assistance is provided to business founders and young entrepreneurs in the start-up area. Free workshops and training sessions on topics of everyday business are offered as well as small, affordable office spaces.

Founders Labs[19] support aspiring entrepreneurs and founders with a two-month, part-time program to help them get started.

All funding programs of the Vienna Business Agency can be found here: viennabusinessagency.at/funding/programs

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viennabusinessagency.at/startup-and-grow/founders-lab-future-technologies

In the alphabetical list[20] on the following pages, we offer you an overview of selected companies from Vienna that offer services in the sustainable construction sector.

Companies from the sustainable construction sector

INSTITUTION	BESCHREIBUNG	WEBSITE
3:0 LANDSCHAFTS-ARCHITEKTUR GACHOWETZ LUGER ZIMMERMANN OG TECHNICAL OFFICE FOR LANDSCAPE ARCHITECTURE	3:0 landscape architecture is a planning office in Vienna. Since its foundation 20 years ago, both the office and the scale of the projects have steadily increased. The three partners and 8 employees are primarily dedicated to public spaces and the diverse and complex requirements of squares, streets, parks and facilities. One focus of 3:0's activities is the adaptation to climate change in inhabited areas. And the role of the urban or street tree. The office plans and researches intensively together with various cooperation partners to improve the habitat for street trees.	www.3zu0.com
ALCHEMIA-NOVA GMBH (ALCN)	ALCN is a non-university research company based in Vienna (14th district). The main focus is on recycling management with nature-based solutions and bio-based industry. The focus is not only on the decontamination of wastewater, soil, landfills and air, but also on the recovery of the substances contained therein for further use. ALCN is involved in a number of international (FP7, H2020) and national research projects (City of the Future, Feasibility Study, Innovation Check) and also offers its services to private companies.	www.alchemia-nova.net
ARCHITEKTURBÜRO REINBERG ZT GMBH	The office has been in existence since 1980 as an independent planning office, since 1985 as a civil engineering office and since 2006 as Ziviltechniker GmbH. The architectural office is mainly concerned with ecological passive houses and plus energy buildings. The team has experience in almost all building areas. More than 100 projects have been realized so far, all of which have a high ecological standard.	www.reinberg.net
BAUCHPLAN).(LANDSCAPE ARCHITECTS AND URBAN PLANNERS	For more than 18 years bauchplan).(has been designing places at the interface between space and society that are climate-friendly and characterized by sociological sustainability. The interdisciplinary team approaches new tasks with the aim of creating multi-layered, enriched spaces of possibility in open design processes.	www.bauchplan.at

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This list makes no claim to being complete.

INSTITUTION	BESCHREIBUNG	WEBSITE
BETONWERKE RIEFENTHALER OHG	The company's product range includes concrete pipes, well rings, manhole rings, cesspools, water cisterns, dead wells, small sewage treatment plants, water meter shafts, cleaning and inspection troughs, cable troughs, concrete slabs, step treads, fox's dens, etc. as well as all types of custom-made products.	www.riefenthaler.at
CITYGREEN GARTEN-GESTALTUNG GMBH	citygreen is a provider of complete solutions for interior and roof greening as well as for the design of outdoor facilities. The company has about 40 employees at the locations Vienna and St. Veit an der Glan. Since 2019, citygreen has been a wholly owned subsidiary of RWA Raiffeisen Ware Austria AG and is thus also rooted in the Lagerhaus Group.	www.citygreen.at
DI KARL GRIMM ENGINEERING CONSULTANT FOR LANDSCAPE PLANNING AND LANDSCAPE CONSERVATION	The area of work includes landscape architecture and landscape planning in the juxtaposition between urban density and landscape expanse. Drafts and planning solutions are developed in a careful examination of the potentials of the specific site and the needs of its users. The aim is to create harmonious design concepts that take into account the ecological context.	grimm.lojnik.net
DIE UMWELT-BERATUNG (EN. ENVIRONMENTAL CONSULTATION)	Since 1988 DIE UMWELTBERATUNG, an institution of Die Wiener Volkshochschulen GmbH, has been informing and advising private households and businesses and has been working in environmental protection projects. It prepares ecological knowledge in an easily understandable and practice-oriented way. It advises private households, educational facilities, institutions and businesses. Inquiries are answered individually and regardless of the company.	www.umweltberatung.at
DIPL. ING. JOHANN WÖSS CERTIFIED AND SWORN CIVIL ENGINEER FOR CULTURAL TECHNOLOGY AND WATER MANAGEMENT	The company's activities in the field of drainage also include: roof, parking lot and road drainage as well as rainwater drainage, infiltration and retention. Seepage tests, seepage basins, soakaways and rainwater retention basins.	wasserwoess.com
DIPL.-ING. SCHATTOVITS ZIVILTECHNIKER GMBH	The range of services offered by the company includes planning in the fields of hydraulic engineering, water supply, sewage systems, odour development in the sewer system, civil engineering and geothermal energy, infiltration systems and drainage. Planning of infiltration plants, which correspond to the normative requirements and the official regulations regarding precleaning and performance, is carried out within the framework of an interdisciplinary coordination with all involved parties.	www.zt-schattovits.at

INSTITUTION	BESCHREIBUNG	WEBSITE
UNIVERSITY OF APPLIED SCIENCES CAMPUS VIENNA STUDY COURSE ARCHITECTURE – GREEN BUILDING	The degree program Architecture – Green Building, an EU-recognized architecture study course, offers a practical and interdisciplinary education with a focus on sustainability during the entire life cycle of a building. The special focus on sustainable construction provides skills in design, construction and project management as well as a detailed insight into integral planning. BIM – Building Information Modeling – plays a central role in this area.	www.fh-campuswien.ac.at/studium-weiterbildung/studien-und-lehrgangsangebot/detail/architektur-green-building-bachelor.html
GEOMATRIX	The expert group GEOMATRIX was founded in 2004 by four independent entrepreneurs. The basic idea was to make the best possible use of their respective experience and competence in the joint implementation of projects and to combine expertise in various fields of geosciences and engineering in order to increase quality. Areas of expertise: applied geology, geotechnics, foundation engineering, geoenergy and geothermal energy, groundwater management, soil and environmental protection, agriculture and surveying.	www.geomatrix.at
GREEN4CITIES GMBH	The design, submission and implementation of research and development projects on the topic of "Urban Green Infrastructure" represents one of the main areas of expertise of Green4Cities. It ranges from research funding to all-inclusive project management. In the past years, the team has successfully implemented numerous R&D projects in national and international funding programs.	www.green4cities.com
GREEN LEGACY GMBH	Polyter GR is a superabsorbent, cellulose-based hydrogel for agriculture and forestry. It serves simultaneously as soil activator, nutrient and water storage. It can store up to 300 times its own weight of water and dissolved nutrients and thus revitalize the soil. Polyter is particularly recommended in the following areas: Forestry, gardening and horticulture, fruit and vegetable growing, ornamental plant cultivation and urban greening. Polyter GR is characterized by high biocompatibility and by the promotion of sustainable plant growth.	www.polyter.at
GRÜNSTATTGRAU FORSCHUNGS- UND INNOVATIONS GMBH	The competence center for green building promotes innovation and implementation for the green, smart city of the future. GRÜNSTATTGRAU is an interface between network partners from the public sector, industry and research. In the long term, quality assurance is funded and new awareness is created for the range of services of green buildings in the context of climate change and energy.	gruenstattgrau.at

INSTITUTION	BESCHREIBUNG	WEBSITE
HBLFA GARTENBAU SCHÖNBRUNN	The Federal Secondary School and Research Institut (HBLFA) Schönbrunn und Austrian Federal Gardens is subordinated to the Federal Ministry for Agriculture, Regions and Tourism. The Federal Ministry of Education, Science and Research is responsible for educational matters. The HBLFA is also home to the “Institution of Higher Education (HLA) for Garden and Landscape Design” as well as the “HLA for Horticulture”. The educational institutions are organizationally linked to the research institute and thus guarantee a synergy of the institutions.	www.gartenbau.at
LITE-SOIL GMBH	Lite-Soil GmbH produces internationally successful patented water-saving products for sustainable plant growth in horticulture, landscaping and urban greening. The focus is on geotextiles: These are LITE-DRAINS. Flexible, versatile, perfectly adapted, cost- and water-saving.	lite-soil.com
OPTIGRÜN INTERNATIONAL AG	Optigrün international AG is one of the leading suppliers of roof and building greening. These include retention roofs with a strong flow delay and a static or dynamic throttle, which enable a sustainable use of rainwater and a calculated dimensioning of retention spaces on buildings. Since 2018, Optigrün has had its own research and development department with a focus on rainwater management, which is kept state-of-the-art in cooperation with research institutes and universities.	www.optigruen.at
RIOCOM – ENGINEERING OFFICE FOR CULTURAL TECHNOLOGY AND WATER MANAGEMENT	RIOCOM, an engineering office for cultural technology and water management, was founded by company owner Albert Schwingshandl in 2001 and currently employs 11 people. The range of competence includes river restoration, risk management, flood protection, disaster prevention and simulation.	riocom.at
SIEDLUNGSUNION GEMEINNÜTZIGE WOHNUNGS- UND SIEDLUNGSGENOSSENSCHAFT M.B.H.	The history of the SIEDLUNGSUNION goes back to the time of the great housing shortage after the First World War and is inseparably connected with the legendary “Viennese settlers’ movement”. The Siedlungsunion regards itself as a modern, knowledgeable and socially oriented company whose task is to create, maintain and manage socially affordable housing and living space.	www.siedlungsunion.at
CITY OF VIENNA MUNICIPAL DEPARTMENT 22 – ENVIRONMENTAL PROTECTION	The Vienna Municipal Department of Environmental Protection (MA 22) is entrusted with many important issues of environmental protection in Vienna in the sense of preventive, integrative and partnership-based environmental protection. The primary goal is to avoid environmental pollution and to integrate environmental (protection) concerns into all relevant areas of policy (e.g. energy, regional planning, transport) through a preventive, holistic and partnership-based approach.	www.wien.gv.at/kontakte/ma22

INSTITUTION	BESCHREIBUNG	WEBSITE
CITY OF VIENNA MUNICIPAL DEPARTMENT 42 – PARKS AND GARDENS	The Municipal Department Parks and Gardens of Vienna takes care of the daily horticultural care and design of gardens, parks, children’s playgrounds, green strips, avenues and other areas. The park mission statement defines the principles and guidelines for the design and furnishing of parks in Vienna.	www.wien.gv.at/kontakte/ma42/index.html
CITY OF VIENNA MUNICIPAL DEPARTMENT 45 – WATER MANAGEMENT	The Municipal Department 45 is responsible for standing and flowing surface waters as well as ground waters in the Vienna area. The most important tasks of the department are water supervision, care and maintenance of the waters as well as flood protection. The care and maintenance includes the following areas of responsibility: Water pollution control, hydraulic engineering, hydrography and the clean-up of contaminated sites.	www.wien.gv.at/kontakte/ma45/index.html
CITY OF VIENNA EXECUTIVE OFFICE FOR CONSTRUCTION AND TECHNOLOGY (MD–BD)	The Executive Office for Construction and Technology (MD-BD) is responsible for securing the technical and spatial basis for the city. It forms the bridge between business, politics and administration. It ensures that public buildings, parks, squares and bridges, as well as canals, lighting, water pipes and garages are constructed as needed. The Executive Office for Construction and Technology is part of the municipal administration. It also manages all technical measures within the framework of the Smart City Wien Framework Strategy.	www.wien.gv.at/kontakte/md-bd
CITY OF VIENNA WIEN KANAL	With a total length of 2,475 kilometers, Wien Kanal is Austria’s largest sewer system operator. 99.8 percent of all households in Vienna are connected to the urban sewer system. The enterprise employs approximately 450 employees. The range of tasks covers the maintenance and repair of the sewer system with all its components as well as its further development, which also includes the construction of rainwater storage basins and other facilities that protect the sewer system from being overloaded.	www.wien.gv.at/umwelt/kanal
TATWORT NACHHALTIGE PROJEKTE GMBH	The current service portfolio and the main area of expertise of tatwort – Sustainable Projects combines communication and participation expertise and professional project management with content-related expertise in the fields of renewable energies, environment, water, climate protection, sustainable consumption and efficient use of resources. The company solves complex interdisciplinary problems across industries and innovatively in consortia of business, science and administration.	www.tatwort.at
TEAM KERNSTOCK ZIVILTECHNIKER GESELLSCHAFT MBH FOR CULTURAL TECHNOLOGY AND WATER MANAGEMENT	The company offers solutions, consulting and support for municipalities, associations, cooperatives, companies and individuals. The fields of activity include: urban hydraulic engineering, flood protection, transport, rainwater management, hydraulic engineering, raw materials & waste management.	www.kernstock-zt.at

INSTITUTION	BESCHREIBUNG	WEBSITE
VIENNA UNIVERSITY OF TECHNOLOGY DEPARTMENT OF WATER QUALITY AND RESOURCE MANAGEMENT	Field of activity: Analysis, evaluation and design of systems for sustainable management of resources and waste. Biological, technical and operational aspects of wastewater treatment as well as water emissions, resource management and measurement technology are the focus of the scientific work.	iwr.tuwien.ac.at/wasser
UNIVERSITY OF NATURAL RESOURCES AND APPLIED LIFE SCIENCES VIENNA INSTITUTE FOR ENGINEERING BIOLOGY AND LANDSCAPING	The field of landscape architecture, integrated into the institute for engineering biology and landscape architecture, is understood as central field of knowledge and technology in the context of landscape architecture and open space planning, when it comes to turning the plan into built reality. The attempt is made to account for this wide angle of view also in research and teaching.The imparting of the competences necessary for the vocational field of landscape architecture and landscape planning in the material and constructional area is practice-oriented and based on a well-founded research activity.Within the University of Natural Resources and Applied Life Sciences (BOKU), landscape architecture provides contributions to the competence fields of “Habitat and Landscape” and “Renewable Resources”.	boku.ac.at/baunat/iblb
UNIVERSITY OF NATURAL RESOURCES AND APPLIED LIFE SCIENCES VIENNA INSTITUTE FOR URBAN HYDRAULIC ENGINEERING, INDUSTRIAL WATER MANAGEMENT AND WATER PROTECTION.	The Institute for Urban Hydraulic Engineering, Industrial Water Management and Water Protection (SIG) is committed to sustainably securing the basis of life for future generations. Water plays an important role in this context, it is part of the provision of services of general interest, and its protection is therefore our primary objective. The SIG Intitute sees itself as a mediator between competing demands for the use of water as a resource and endeavours to create a basis for scientifically sound, objective and comprehensible decisions in this respect. The SIG Intitute aims to live up to this responsibility towards society, both in research and in teaching. The SIG Intitute feels obliged to make the knowledge gained available to the public and to offer services within the scope of its possibilities. Internationalization is an important concern of the SIG Intitute, which has dedicated a separate field of competence to development cooperation and is also active in the EU accession and candidate countries, among others.	boku.ac.at/wau/sig
VERTICAL FARM INSTITUTE	Vertical Farming enables the year-round, sustainable cultivation of food on the smallest possible area by means of vertical cultivation methods and by using natural energy resources. The vertical farm institute is researching and planning the future of food together with regional and international partners.	www.verticalfarminstitute.org

INSTITUTION	BESCHREIBUNG	WEBSITE
WEATHERPARK GMBH METEOROLOGICAL RESEARCH AND SERVICES ENGINEERING OFFICE FOR METEOROLOGY	The company prepares analyses of cities and communities according to meteorological aspects. Starting from the status quo, concepts for the improvement of local conditions with regard to a healthy urban climate are created, so that a pleasant quality of life outdoors is guaranteed. The entire transformation process can be accompanied: from strategic consulting, through the development of planning processes, to the training of the personnel involved.	www.weatherpark.com
WIEN 3420 AG	The central contact for the Urban Lakeside Town (Seestadt).Wien 3420 aspern Development AG is developing a city where over 20,000 people will live and thousands of people will work by 2028. Together with its partners, the development company coordinates urban development and the expansion of the infrastructure in the Urban Lakeside Town. The multidisciplinary team contributes a wide range of experience and is a sparring partner for investors, developers and companies.	www.aspern-seestadt.at/ueber_uns/wien_3420_ag
WIENER UMWELT-ANWALTSCHAFT (WUA) VIENNESE ENVIRONMENTAL OMBUDSMAN (WUA)	The Viennese Environmental Ombudsman (WUA) was founded through the Environmental Protection Act 1993 as an independent institution of the Province of Vienna. The primary aim of the Environmental Ombudsman’s Office is to protect the interests of environmental conservation on behalf of the citizens of Vienna and to thus contribute to improving the environmental situation in Vienna. It responds to queries and complaints of the Viennese people with expert information and advice. The Environmental Ombudsman is in constant cooperation with all environmentally relevant institutions in Vienna. Within the framework of these partnerships, approaches to solving Vienna’s environmental problems are developed in close dialogue.	www.wua-wien.at
ZENEBIO GMBH	Zenebio is an acronym. It stands for “Zentrum für nachhaltige Entwässerungssysteme auf biologischer Basis” (en.: “Centre for biologically-based sustainable drainage systems”) and has successfully operated in the field of landscaping and the production of soil additives for decades. Zenebio GmbH has always regarded itself as a centre for the development of innovative, nature-based solutions for sustainable cities in the field of landscaping.	zenebio.at

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