



# Solutions for the smart urban space

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# Editorial

Dear readers,

Digitization is gaining more and more momentum: The accompanying automation simplifies everyday processes in various areas of life. Demands for reliability in various processes are increasing. Flexibility and immediate response options to events are becoming increasingly important.

With regard to "smart cities", we can consider the example of traffic optimization: digital traffic light control makes it possible to immediately adapt the flow of traffic to the current number of vehicles. The same applies to wayfinding systems at major events, which distribute people evenly across different routes and passages. Sensors provide information about the availability of parking spaces and thus save people from a time-consuming search. Advertisements can be edited or exchanged from a PC. Localization information from terminal devices helps detect traffic hazards early and thus prevents accidents. On top of that, as long as daily tasks can be completed easily on the move via mobile devices, everyone benefits from unprecedented mobility.

To implement all these functions, it is necessary to either transmit large volumes of data or greatly increase the response speed of the wireless network. They are therefore only conceivable in conjunction with the expansion of the 5G network. The challenge for municipalities is to appropriately integrate 5G radio stations and antennas into the cityscape and thus set the course for a digital future. Moreover, the realization of digital systems is always a joint project: many different players come together to actualize the project step by step. Experts from different industries contribute their know-how about the production of different useful objects, their inner electronics, their configuration, or the programming of applications. Coordinating such a complex interaction is not easy – which makes finding a common direction all the more important.



But we must not forget that this direction cannot be "digitization at any cost". Ultimately, as flesh and blood human beings, our lives are analog. Our aim in this context should be the combination of analog technologies where they make sense with digital solutions where they make our work easier. We also need to strike a balance between new technologies and a sustainable, resource-conserving approach to our environment. Every municipality is faced with this difficult area of tension and has to master the resulting balancing act.

In this report, you will find an urban furniture concept that combines spatial design, 5G network expansion, digital functions, sustainability, and ecological issues. I hope you find it informative reading.

Prof. Dr.-Ing. Stephan Ludwig,  
Radiocommunication Technology and  
Signal Processing, Aalen University

# Innovative Street Furniture for the Smart Urban Space



## Urban space as a “smart city”

The needs of modern society are becoming increasingly complex in the face of advancing digitalization. Actualizing the concept of a “smart city” requires a targeted approach that combines sustainable design of public spaces with the complex requirements of technology, materials, and ecology. Our innovative street furniture is one such approach.

Our street furniture concept combines various functions: The furniture serves as a seating, lounging, and shelter area, and creates a meeting space for social interactions. Integrated lighting systems increase people's sense of security in public areas at night. Since the furniture serves as WiFi hotspots and charging stations for mobile devices via USB ports or induction, it provides users with easy access to the digital requirements and services of everyday life – even when on the move. The power required for digital services is self-generated by the system via solar panels. Batteries allow electricity to be stored for times of day or year when the sun is not shining. Surplus electricity can be fed into the public grid.

The nationwide expansion of the 5G network is a challenge – especially in urban environments. Our street furniture concept offers a practical solution to this: the material is radiolucent which allows antennas to be accommodated without being visually intrusive.

The design of our furniture aims to support the greening of cities. From integrated green spaces suitable for tree planting to innovative planting concepts such as “green walls”, our street furniture concept offers a wide range of options for enhancing the design of urban space while simultaneously having positive effects on air hygiene and biodiversity.

Our street furniture is designed as a modular system, so that seating or lounging facilities, tables and storage options, waste and recyclables bins, bicycle racks, and planting objects can be combined with each other as desired. This results in a varied but consistent appearance.

The materials are both fire resistant and robust – and are thus vandalism-, corrosion- and weather-resistant, and particularly durable. This eliminates the need for costly maintenance or replacement of furniture elements.

Street furniture in urban environment



# Functional and Smart Outdoor Furniture

## Outdoor mobility and digital networking

Our furniture fulfills just as many functions in outdoor areas as it does in urban spaces. While it serves as a desired place for rest and recreation for visitors to tourist regions during diverse activities in nature, seating and lounging options offer relaxation, while waste and recyclable material containers prevent environmental pollution. Visitors can also connect to digital functions via the charging station for mobile devices and the integrated WiFi hotspot.

The expansion of climate-friendly e-mobility is served by creating charging stations for e-bikes at regular intervals to make traveling by bicycle more attractive – especially in tourist areas. The electricity required for this is generated by integrated solar panels and can be stored in a battery. The system is therefore self-sufficient and offers an uncomplicated way of networking the outdoor area with a “digital lifestyle”.

The robust material is resistant to corrosion and weathering and thus easily withstands outdoor conditions. Maintenance in this scenario also does not require extensive upkeep.



# Materials and Processes

## Fiber composites

C.F. Maier is an expert in the processing of fiber composites. This involves combining fiberglass or carbon fibers with a polyester or epoxy matrix. Our street furniture concept is to be actuated using a material mix based on fiberglass reinforced plastic (FRP). On the one hand, this composition makes it possible to increase the radio wave permeability of FRP without sacrificing stability, weather resistance, or durability. FRP is ideal for outdoor use: FRP components for commercial vehicles made by C.F. Maier are often exposed to punishing conditions – and have proven themselves over many years. Our recyclables containers for the recycling industry and cover systems for sewage treatment plants have also been in successful use for decades. One of the oldest covers has been in use for over 40 years and is in a major German chemical industry plant to this day.



Driver's console in the Citaro city bus by Mercedes-Benz



PistenBully Cab by Kässbohrer

## Processing methods

The pre-series of our products is often done by hand laminating. In this process, fiberglass mats are impregnated with synthetic resin and then manually rolled into a mold in several layers. This allows large surface-area parts to be produced economically in small quantities. Series production of these street furniture products is envisaged using the RTM process, in which fiber mats are impregnated with resin in the mold and cured under vacuum. Because the process is ideally suited to producing components with smooth surfaces on both sides, it is a good fit for these requirements and geometries.



SCA pop-up roof



Exterior and interior view of a city bus wheel arch cover



Cover system by C.F. Maier



Recyclables container "Oekotub" by C.F. Maier



The fully electric Mercedes-Benz eCitaro



Truck model XF by DAF

# Project Sequence and Partners

Expertise for a digital future

Our street furniture's design concept was developed in collaboration with students from the University of Design Schwäbisch Gmünd and external architecture consultants. The experts for digital future of the Center for Digital Development (the ZDE) provided know-how within the thematic field of the "smart city", including on issues of digital networking and sustainable ecological interior design. The company Geo Data advised on the technical concept for 5G network expansion.

In addition, the first municipalities from the smart city initiative have already become useful sparing partners for C.F. Maier early in the project.

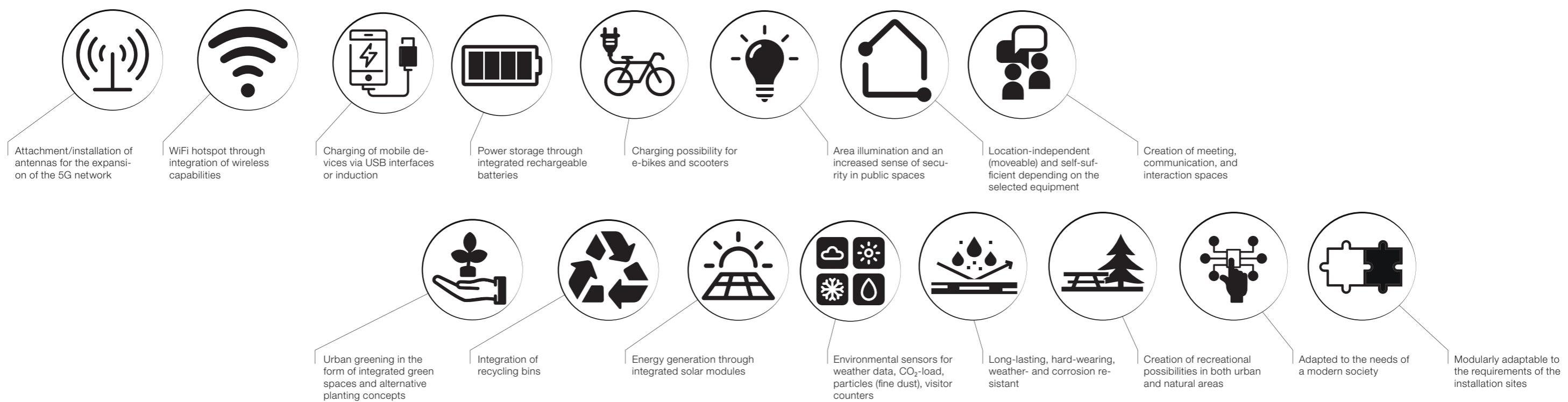
Municipalities' specific requirements for the street furniture concept were incorporated into the product designs. Fruitful communicative exchanges enabled the optimization of furniture as early as the development phase.

The materials to be used underwent various test procedures in-house. The material was also examined with regard to its radiolucency in cooperation with an external testing laboratory.

Obtained data will be used to develop the ideal material mix of fiberglass reinforced plastic and other components.



Excerpt from the diverse requirements catalog



# Product Family “city:hub”

Geometric shapes combined  
in a variety of ways

The “city:hub” product family was designed on the basis of predominantly simple and linear shapes. Flat elements dominate, and these are aligned with each other using fixed length ratios. Canopies protect against rain and can also accommodate solar panels.

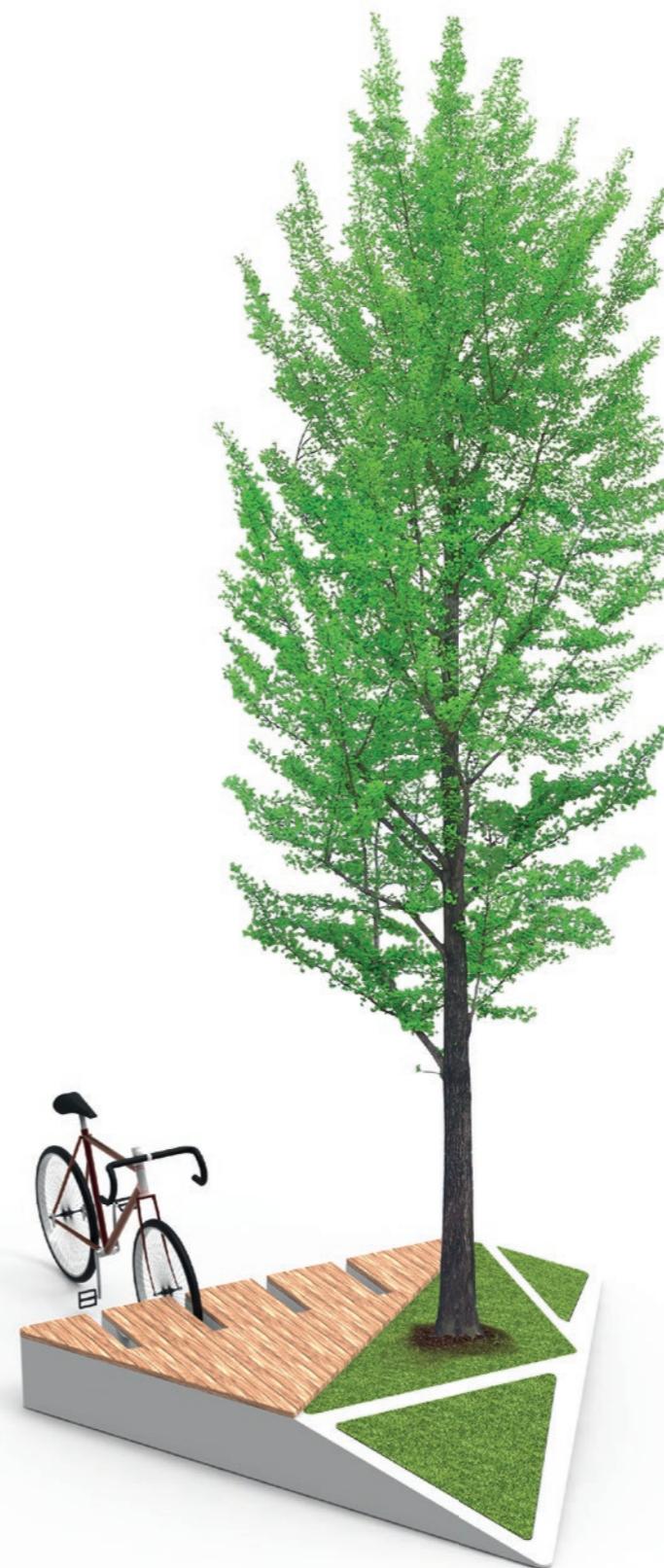
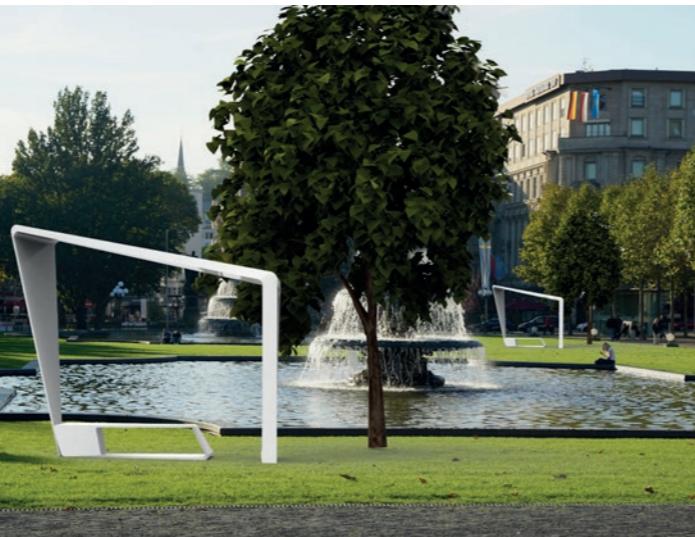
Furthermore, this allows 5G antennas to be positioned in the best possible way: the mobile network's transmission range improves with higher mounting.

The form of the design features is repeated in each product of the family. With the help of related form elements such as a trapezoidal or rec-

tangular shapes, stand-alone objects such as planters or recyclables and waste containers can also be integrated.

In addition, this modular system enables the combination of different functions: Seating with garbage cans, lounging facilities with canopies, bicycle racks with planters, display boards with storage tables, and much more.

Floor elements that primarily serve urban greening also have optional wooden inserts that can be used for storage, seating, or parking/charging stations for bicycles.



Vertical greening of  
the side wall



Covered bicycle stand  
with solar module



Green walls for air hygiene, sound insulation, and ecology

In addition to ground elements, which are intended for green areas, planters can also be created on vertical areas. These are used either alone or combined with other modules such as canopies.

"Green walls" add aesthetic value to cities, and have also been shown to lighten moods – thus generating positive effects on the human psyche. The fact that "green walls" absorb sound and significantly reduce the noise level in busy urban areas also increases well-being. In summer, the plant areas/surfaces also prevent the formation of urban heat islands by providing shade and reducing temperatures.

Green spaces reduce air pollution by absorbing nitrogen dioxide and binding particulate matter. They also significantly reduce CO<sub>2</sub> levels.

From an ecological point of view, "green walls" are a simple but efficient way to protect the climate. Plant walls also provide a habitat for birds and insects, and promote species conservation and biodiversity.

"Green walls" are indispensable in view of their multiple benefits in relation to the relevant issues of modern and sustainable urban design.

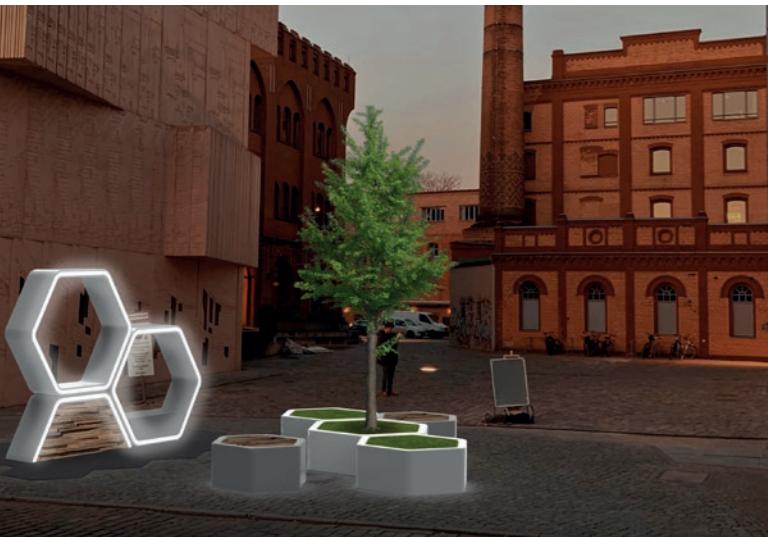


# Product Family “city:mod”

## Freely combinable modular system

The “city:mod” product family is designed as a modular system based on a hexagonal shape. It is oriented both vertically and horizontally. Vertically oriented objects have a uniform size. The height of the vertical system makes it necessary to ensure a secure hold on the floor, since the furniture is used primarily as a sitting and reclining surface. The elements are affixed to the ground, and have the advantage of reversible anchoring. The furniture can be moved at any time.

Horizontally oriented objects are designed in different sizes. They can be grouped or positioned freestanding. The space within the hexagon can be equipped with functional elements as needed – serving as a seating or storage area, a planting container, or rainwater collection. With additional metal elements, the objects can be turned into bicycle racks. Different sizes and heights not only make storage and transport more economical through nesting, but also multiply the possibilities of use.



Diverse combinations for any environment



## Additional product: The practical bicycle box

A bicycle box with a hexagonal basic shape was designed based on the modular system of the “city:mod” product family. This offers visitors the possibility of parking, and, if necessary, charging bicycles and e-bikes. High-quality bikes can be stored safely in the box while visitors enjoy their stay and visit nearby sights without worries.

The box can hold four bikes standing upright. This position is particularly space-saving. The roof is equipped with solar panels, so the energy for charging the e-bikes is generated by the box itself and no separate connections are needed. In low light conditions and at night, lighting elements illuminate the space both inside and outside the box.

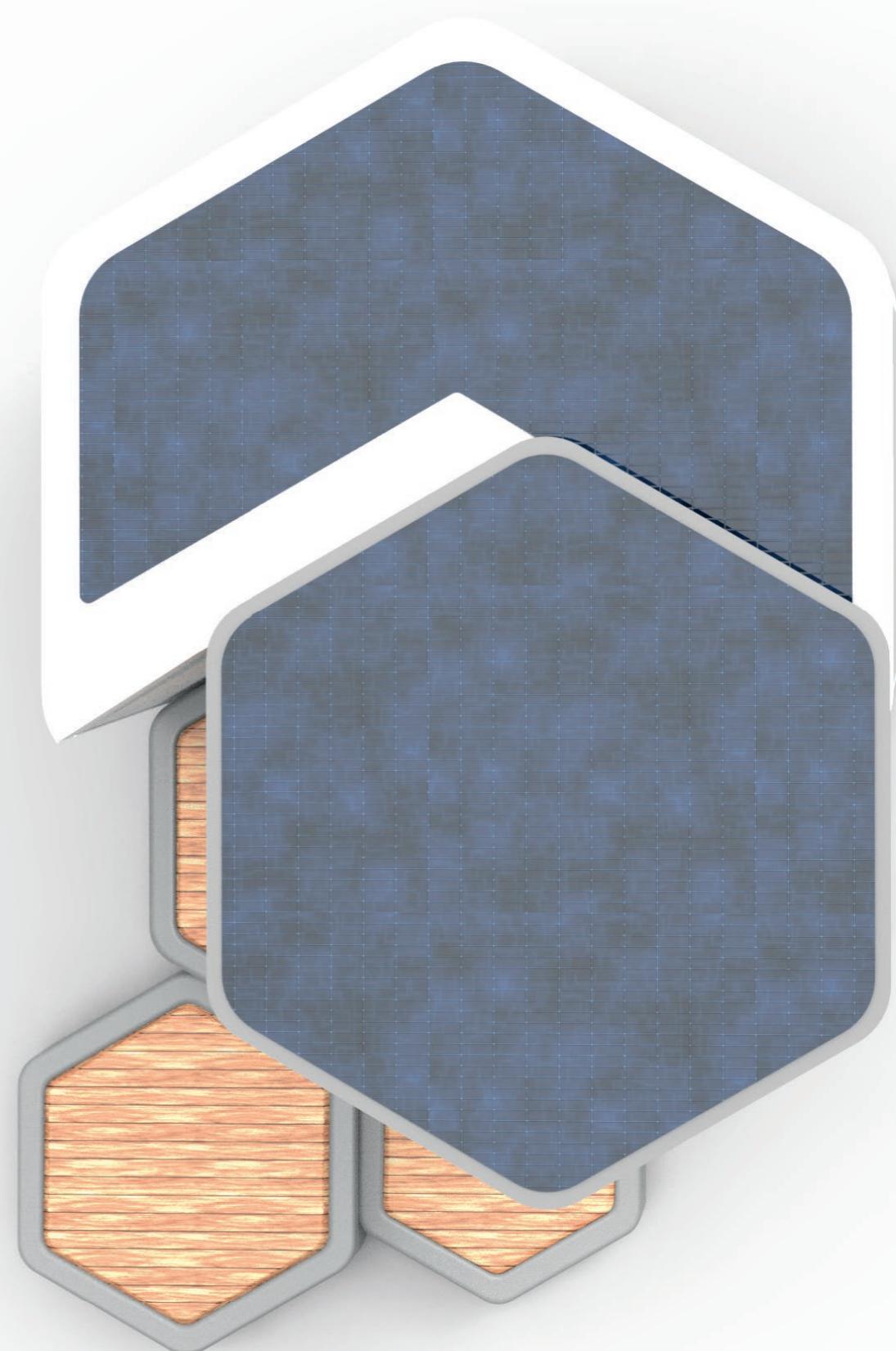
The box can be combined with other elements of the product family (such as seating and storage areas), but can also be expanded as needed with additional boxes, so that several lockable bike lockers can easily be offered at one location.



Functional with countless creative possibilities

The hexagonal shape makes it possible to think beyond the obvious functions of sitting, lying down, or charging electronic devices. When erected, hexagons are space-creating and it is therefore essential to consider them as architectural elements in public spaces. Several honeycombs placed on top of each other can simultaneously act as a sculptural element. The combination and overlapping of different hexagonal geometries – regardless of size – is always harmonious in terms of design and results in countless possibilities.

Elements are also well suited to being arranged in a playground landscape. Depending on placement, the shapes create tunnels, climbing walls, and invite possibilities for jumping or hiding games. This does not require a laboriously planned arrangement concept, as randomly arranged elements challenge children's inventive spirit: numerous creative playful possibilities are conceivable in, on, or around the furniture. Its diversity thus allows this street furniture to be as much a place of relaxation as of adventure.





### Model Project: Heidenheim, Germany

Together, the southern German cities of Aalen and Heidenheim have launched an inter-municipal model project with the aim of making their public spaces smarter. Our smart city furniture is an important part of this project.

On this page you can see pictures of the waiting area with solar panel and display, which was installed in Heidenheim at the end of October.



# Unique and Individual Design Alternatives

During the development process, a variety of design approaches and ideas for street furniture emerged.

All design series combine various functional elements such as seating, bike racks, and garbage cans.

The following selection of concepts is intended to create an impression of how varied design possibilities can be in the realm of street furniture. Individual requests and requirements can also be met with the selected materials and manufacturing processes.



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