levelup

Project Manual

DEL#6 23.03.2022

solar decathlon 21›22 europe

WUPPERTAL GERMANY ...goes urban!


levelup
Hey, Servus!
We are team levelup.

31 Summary of changes

	Changes	Date
rules checklist	update	D#6
architecture design report 1. Neighbourhood 2. The whole Building – Design Challenge 2.1 Design of the building 3. The House Demonstration Unit (HDU) 3.1 Architecture Concept 3.2 Interior design 3.3 Lighting Design 3.4 Solar System Integration	update update update new update new new new new	D#6
engineering & construction report 1. Design Challenge 2. Transfer to HDU 3. Comprehensive Energy Analysis	update update update new	D#6
affordability & viability report 37.1 Analysis 37.2 Definition 37.3 Concepts	update update update update	D#6
cesa report 38.1 Communications sub-Report 38.3 Stretgic Planning c) Messages: Vision and positioning our communication d) Online Strategy 38.4.Operative planning a) Website b) Social Media d) Newsletter f) Public Relations g) Brochures h) Professional articles i) Events k) Lectures l) Posters m) Visits to building Project n) Guided tours and workshops 38.5.Implementation, Assessment / Controlling 38.6.Education Sub-Report 38.7.Social Awareness Sub-Report 38.8 Mandatory Attachments a) Team Visual Identity Manual b) Sponsorship Manual c) Public Tour Description d) Implementation List Appendix	update update	D#6

sustainability report 1. Circularity 1.1 Materials 1.2 Construction and maintenance 1.3 Circular economy concept 1.4 Carbon footprint of the construction 2. Sufficiency, Flexibility & Environmental Performance 2.1 Biodiversity 2.2 Society 2.3 Climate 2.4 Durability 2.5 Building Materials	update new new new new new new new new new new new	D#6
urban mobility report CI layout customizations Subheadings District Level: City of Nuremberg District Level: Ludwigsfeld Building Level: Ludwigsfeld Mobility Concept Implementation in the HDU Appendix	update update update update update update update update update	D#6
dinner party menu recipes team levelup Allergens & Additives Cost evaluation & energy consumption nutritional information & local share of ungredients	update update new new new	D#6
contest week tasks‘ planning	update	D#6
cost estimate & project financial summary Business & Fund-Raising Plan Fund-Raising Overview	update new new	D#6
site operations plan	update	D#6

hs report & documentation General Data of the Project Health & Safety Plan Objectives Individual protection resources to use (PPE) Accident prevention regulations training Planned measures in case of an accident Health & Safety Analysis Health & Safety Checklist Instruction Concept Including Contents Construction-site conditions and crucial data related to the prevention of risks during the construction process Activities for Risk Prevention Critical work phases for risk prevention Risk identification and efficacy evaluation of the adopted measures Collective protection utilization Safe working procedures for every team member Machinery and auxiliary resources Risk identification for construction-site work Useful plans and information about health and safety Adopted system for the level of health and safety control during construction Formation and information about health and safety Emergency evacuation plan during assembly and disassembly phases HS statement HS medical statement HS training statement	update update update update update update update new new new new new new new new new new new new new new update new new new	D#6
detailed water budget Detailed water budget Detailed water budget - example Appendix	update update new new	D#6
electrical & pv design systems information	update	D#6
project calculations	update	D#6
structural calculations	update	D#6
Appendix	update	D#6

32 Table of Contents

33 Rules Checklist

✓ 3.2 Team Officers & Contact Information
Team officer's contact information completely fulfilled in Table 2 (SDE21 WAT).

x 4.3 Lot Conditions & attribution
Drawing(s) showing the storage and unloading areas and corresponding load's calculations.

x 4.3 Lot Conditions
Calculations showing that the structural design remains compliant even if there is a level difference, and drawing(s) showing shimming methods and materials to be used if needed.

x 4.4 Footings
Drawing(s) showing the locations and depths of all ground penetrations on the Competition site.

x 4.4 Footings
Drawing(s) showing the location, contact area and soil-bearing pressure of every component resting directly on the ground.

x 4.7 Construct Equipment
Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the Competition site and specifications for heavy machinery.

✓ 5.1 Solar Envelope Dimensions
Drawing(s) showing the location of all unit and site components relative to the solar envelope.

✓ 6.1 Structural Design Approval
Structural drawings and calculations signed and stamped by a qualified licensed professional.

✓ 6.1 Electrical & Photovoltaic Design Approval
Electrical and Photovoltaic drawings and calculations signed and stamped by a qualified licensed professional.

✓ 6.1 Codes Design Compliance
List of the country of origin codes complied, properly signed by the faculty advisor.

✓ 6.2 Architectural Footprint
Drawing(s) showing all information needed by the Rules Officials to digitally measure the architectural footprint.

✓ 6.2 Architectural Footprint
Drawing(s) showing all the reconfigurable features that may increase the footprint if operated during Contest week.

✓ 6.3 Measurable Area
Drawing(s) showing the Measurable Area.

✓ 6.4 Entrance & Exit Routes
Drawing(s) showing the accessible public tour route, specifying the entrance and exit from the unit to the main street of SDE21 Solar Campus.

✓ 7.3 PV Technology Limitations
Specifications and contractor price quote for photovoltaic components.

✓ 7.4 Batteries
Drawing(s) showing the location(s) and quantity of stand-alone, PV-powered devices and corresponding specifications.

✓ 7.6 Thermal Energy Storage
Drawing(s) showing the location of thermal energy storage components and corresponding specifications.

✓ 8.1 Containers locations
Drawing(s) showing the location of all the water tanks.

✓ 8.2 Water Delivery
Drawing(s) showing the fill location(s), quantity of water requested at each fill location, tank dimensions, diameter of opening(s) and clearance above the tank(s).

✓ 8.3 Water Removal
Drawing(s) showing the quantity of water to be removed from each fill location, tank dimensions, diameter of opening(s) and clearance above the tank(s).

✓ 8.5 Greywater reuse
Specifications for greywater reuse systems.

✓ 8.6 Rainwater Collection
Drawing(s) showing the layout and operation of rainwater collection systems.

✓ 8.8 Thermal Mass
Drawing(s) showing the locations of water-based thermal mass systems and corresponding specifications.

✓ 8.9 Greywater Heat Recovery
Specifications for greywater heat recovery systems.

✓ 9.1 Placement
Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system.

x 9.2 Watering Restrictions
Drawings showing the layout and operation of greywater irrigation systems

✓ **10.2 SDE21 Sensors' Location & wire routing**
Drawing(s) showing the location of bi-directional meters, metering box, sensors, cables and feed-through to pass the instrumentation wires from the interior to the exterior of the unit.

✓ **11.2 Use of the SDE21 Logo**
Artwork, and content of all communications materials, including signage (please refer to the SDE21 Graphic Chart & Brand Manual).

✓ **11.3 Teams' sponsors & Supporting Institutions**
Drawing(s) showing the dimensions, materials, artwork, and content of all communications materials, including signage (please refer to the SDE21 Graphic Chart & Brand Manual).

✓ **11.4 Team Uniforms**
Drawing(s) showing the artwork, content and design of the Team uniform (please refer to the SDE21 Graphic Chart & Brand Manual).

✓ **12.4 Public Tour**
Drawing(s) showing the public tour route, indicating the dimensions of any difficult point, complying with the accessibility requirements.

x **23.0 Contest 5: Drying Method**
Drawing(s) showing the clothes drying method and the place where the clothes will be dried.

x **23.0 Contest 5: House Functioning**
Appliances and corresponding technical specifications (Appliances and Home Electronic Equipment specifications and user manuals).

✓

36.5 Photovoltaic systems design
Specifications of PV generators, inverters, wiring, cables, protections, earthing systems, interface with the electricity
✓ distribution network turned on.

36.5 Photovoltaic systems design
✓ Inverters' certificates.

36.5 Photovoltaic systems design
Maintenance plan for PV generators, supporting structure, inverters, wiring, cables, protections, circuit breakers in case of fire and earthing system. Fire protection systems for
✓ PV DC wiring.

36.5 Photovoltaic systems design
The corresponding table 'design summary' must be completed.

51.3 Fire Safety
Specifications for Fire Reaction of Constructive elements, extinguishers, and fire resistance of the unit's structure.

51.3 Fire Safety
Drawings showing compliance with the evacuation of occupants' requirements and fire extinguishers location

✓ **51.4 Safety against falls**
Specifications of compliance with the slipperiness degree classes of floors included in House Tour

✓ **51.4 Safety against falls**
Drawing(s) showing compliance with conditions for uneven flooring, floors with different level, Restricted Areas stairs, Public Areas Staircases, Restricted Areas Ramps and Public Areas Ramps

✓ **51.4 Safety for impact risk & avoiding trapping**
Drawing(s) showing compliance with conditions for avoiding impact risk and trapping.

✓ **51.4 Safety against the risk of inadequate lighting**
Specifications for level of illumination of House Tour areas light fittings.

✓ **51.5 Accessibility for People with Disabilities and Special Needs**
Interior and exterior plans showing the entire accessible tour route.

✓ **51.6 Structural Safety**
Specifications for the use of dead loads, live loads, safety factors and load combinations in the structural calculati-
✓ ons.

51.7 Electrical and PV Systems
Complete the 'Electrical System Design PV Chart and Checklist'.
✓

51.7 Electrical and PV Systems
Specifications of the wiring, channels, panels and protections of the electrical installation.

✓ **51.7 Electrical and PV Systems**
One-line electrical diagram and drawings showing the grounding, execution and paths.

34 contest support documents

35 Architecture Design Report

Table of contents

1. Neighbourhood

1.1 Site Integration

Solar Decathlon Europe 2021/22 (SDE) addresses many of the current major challenges in the building sector of our time: climate change, environmental degradation, the extinction of species, environmental pollution, resource scarcity, land degradation, and lack of affordable housing. We see the greatest potential for housing expansion in an urban context in „renovation & addition of storeys“. Here, existing buildings can be made climate-neutral through renovation measures, existing resources can be preserved and living space can be expanded without building upon undeveloped green spaces.

For the competition, we are planning an addition of storeys to an existing building built between the 1950s to 1970s. This sustainable, carbon-neutral, and affordable housing is to be built using modular timber construction. This construction method allows for a future-oriented concept design that can be adapted to rapid changes in society in the twenty-first century. Communal areas, green spaces, and attractive contemporary architecture represent a significant upgrade for the building‘s residents and the adjacent neighbourhood.

The addition of storeys does not try to hide in the monotonous image of the residential buildings, but arouses the interest of passers-by through its prominence. This is not only accomplished by drawing ones attention to the „levelup“ system of modular timber construction and its new association with the city, but the architecture also highlights the issue of sustainability in the neighbourhood. This takes the form of a new façade design, a green roof, and the integration of systems for regenerative energy production. Despite its obvious unique selling point, the refurbished building and its vertical addition blend into the neighbourhood. By offering multifunctional spaces and communal roof areas, the building has the potential to become a new social hub in the neighbourhood. Our addition collects and generates energy that can be used for the entire building. An energy load management system also involves the neighbourhood by distributing the surplus solar power at peak times of the day.

The planned climate-neutral addition of storeys built on top of theexisting residential complex in Nuremberg consists of two stories with a combination of greened roofscapes or surfaces equipped with photovoltaic-thermal solar collectors. This benefits both the residents living in the addition of storeys, and adds value for all residents living in the existing building, as well as for the entire neighbourhood. The “levelup” system can be applied to almost all of the existing buildings in the neighbourhood and thus contributes to a sustainable transformation.

Figure 1 – Site Plan Germany

Figure 2 – Site Plan Ludwigsfeld / Nürnberg

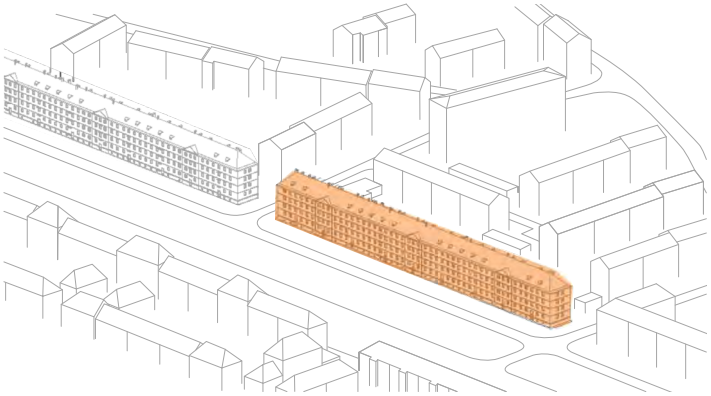


Figure 3 – Competition Area of the Existing Building

1.1.1 Ludwigsfeld

Ludwigsfeld, located in the south-eastern part of Nuremberg, is strongly characterized by a heterogeneous population. The mixed nature of the district is also reflected in the quality of the architecture. North-east of Regensburger Street, elongated apartment blocks dominate the urban development. These predominantly unadorned social buildings have four to seven stories. This streetscape is repeated block by block, street by street, and reflects scenarios of many German cities where similar post-war building types were built to provide a large amount of affordable housing.
„levelup“ offers an innovative solution for identifying and upgrading such neighbourhoods without building on undeveloped ‘green’ spaces between the buildings. To integrate the heterogeneous population in the neighbourhood into the overall architectural picture, an expressive, visionary architecture is to be created that consciously sets itself apart from the existing architecture of the surrounding development. A close look at the immediate surroundings of the existing building reveals that the area is dominated by unused spaces and the dreariness they induce. The lack of perspectives and the existing discrepancies create a diverse potential for positive, future-oriented urban development. Thus, the guiding principle and goal of our concept are to create added value for all residents.
A large percentage of the existing buildings in the neighbourhood were built between 1950 to 1970, which make them similar to the building focused on by the levelup team. This fact made it possible to develop our concept, which is highly flexible and can be undertaken on multiple building with a similar structural configuration.
Detailed analyses of the existing structures, in the form of a feasibility study conducted as part of this project, demonstrated that from the residents‘ point of view there is a lack of leisure, culture, and sport offers. However, these components are fundamental for a successful and sustainable neighbourhood concept.
The design not only expands the usable living space of the existing building, but creates additional possibilities for high-quality spaces for leisure, culture, sport, and living.

1.1.2 Housing extension

We present a system that can identify existing inefficient development structures in a future-oriented way. The special unique selling point is that the increase in density is achieved using a modular construction system that can be adapted to a large number of existing building constructed between the 1950s to the 1970s, given that these structures have similar characteristics typical of this construction typology.
The positive aspects of modularity and flexibility also extend to the actual living level and manifest themselves in a new centre of life with a self-sufficient quality of life for all generations. A short path network and future-oriented mobility concept, to which sufficient foresight and sensitivity have been devoted, are part of the concept. The additional stories create places to stay and communicate, such as roof terraces or greenhouses, which will take on a community-shaping function in the apartment complexes. The result is a breeding ground for a new generation of neighbourly coexistence.

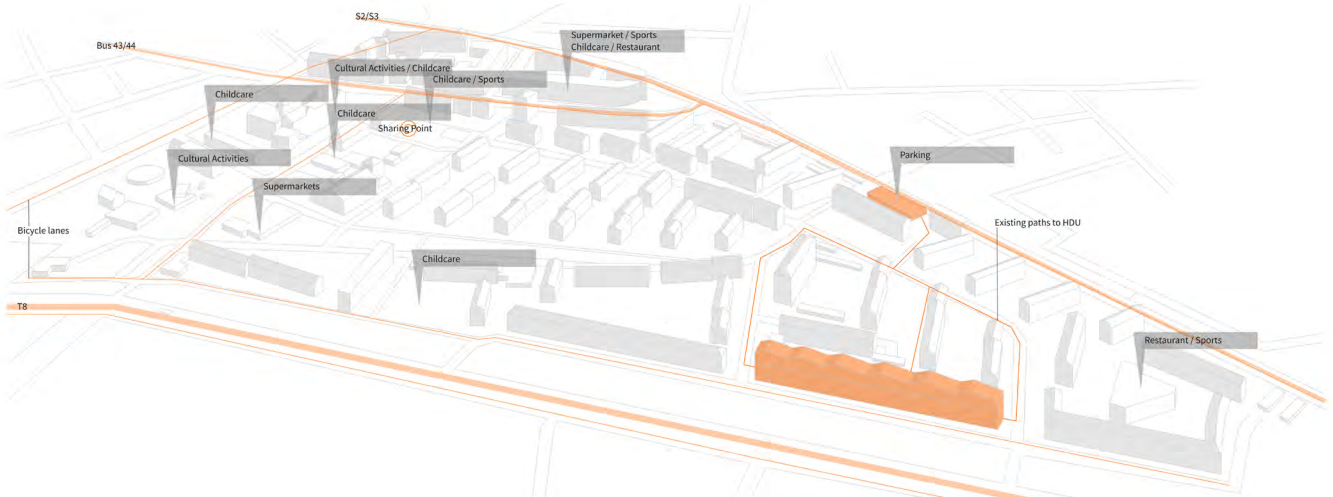


Figure 4 – Urban Mobility Concept / Ludwigsfeld

2. The whole Building – Design Challenge

2.1 Design of the building

2.1.1 General

Our focus is primarily on buildings from the 1950s to 1970s, as this period saw the construction of a large amount of Germany's current housing stock [1], which was built before the first Thermal Insulation Ordinance in 1977, and accounts for a large share of primary energy demand for heating [2]. Multi-family houses represent only 18 % of residential buildings in the German housing stock, but provide 41 % of living space and 54 % of housing units [3]. In our competition entry, we aim to develop a transferable system for as many building typologies as possible and not to design one single solution. Through the „levelup" system, both the individual existing buildings and the surrounding neighbourhoods are to be upgraded and transformed sustainably.

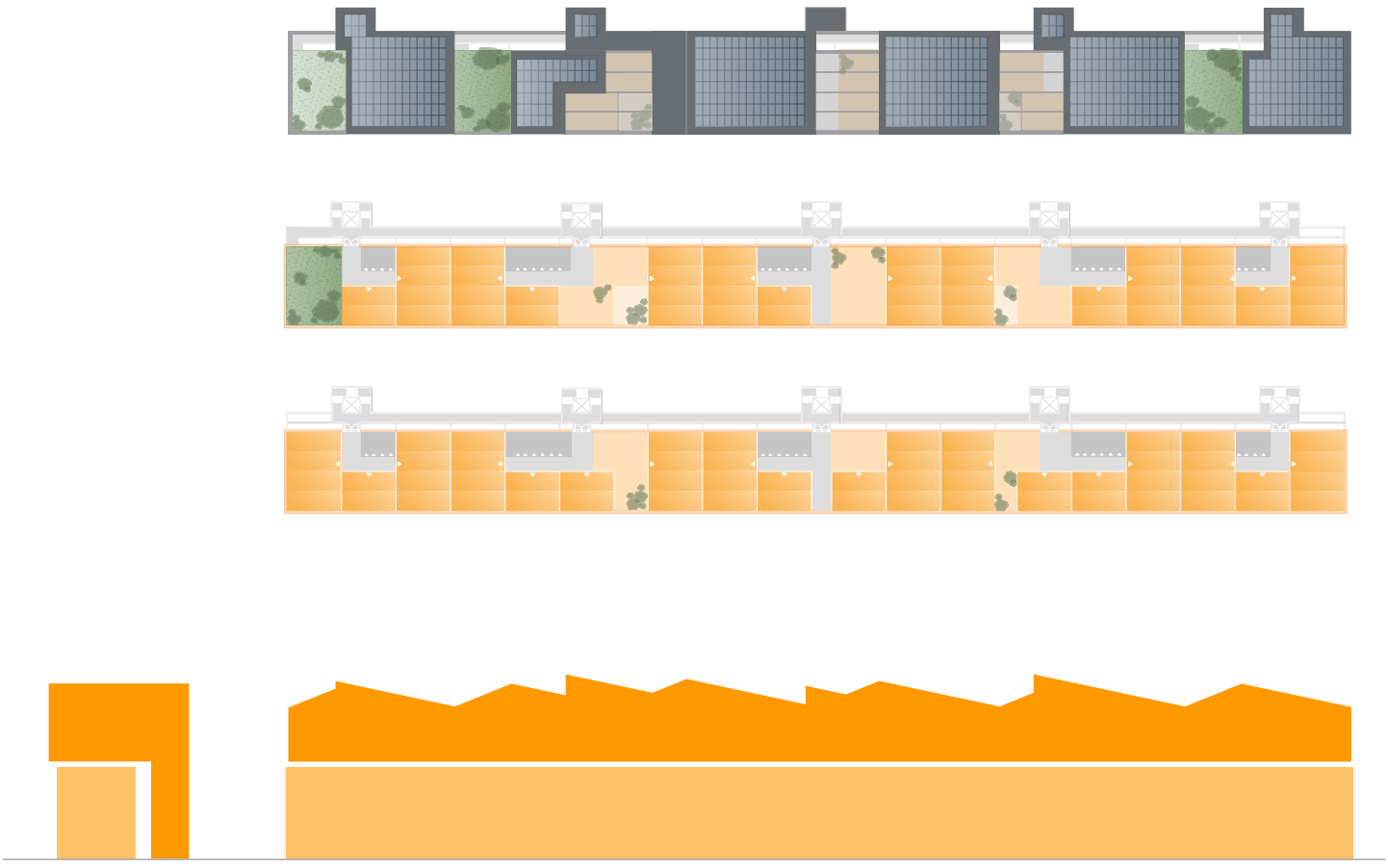


Figure 5 – Schematic Grafic of the additon of storeys

2.1.2 Concept – The levelup system

In addition to a forward-thinking and innovative architectural language, our team was primarily concerned with developing a system that could be adapted to existing buildings from the 1950s and 1970s.
The „levelup“ system was developed in such a way that it can be flexibly adapted to recurring similar building characteristics of these building types, such as building widths between 9.0 - 10.50 meters, building lengths between 30 - 150 meters, structures built with reinforced-concrete ceilings, with load-bearing exterior walls, and a load-bearing interior wall. We see the innovation and the special unique selling point of our design in this modular adaptability. We chose a modular system consisting of wooden modules with the following dimensions: length 7.50 metres X width 2.95 m X height 3.10 m. The resulting dimensions are derived from current lorry transport sizes. The arrangement of the modules is subject to a strict grid, which can be adapted to numerous building, respectively. The staircases play a central role, as they represent both vertical and horizontal constraint points. The modules are arranged between the „immovable“ staircase cores in such a way that a maximum number of room cells can be placed between them in order to close off the gap to the staircases with a threshold. The distances between the existing staircase cores and the modular addition of storeys may vary slightly based on varying existing and newly installed geometries. These must be “bridged” using non-modular installations around the staircases; however, such connecting areas are to be kept to a minimum, as the goal is to build using modular, prefabricated units.

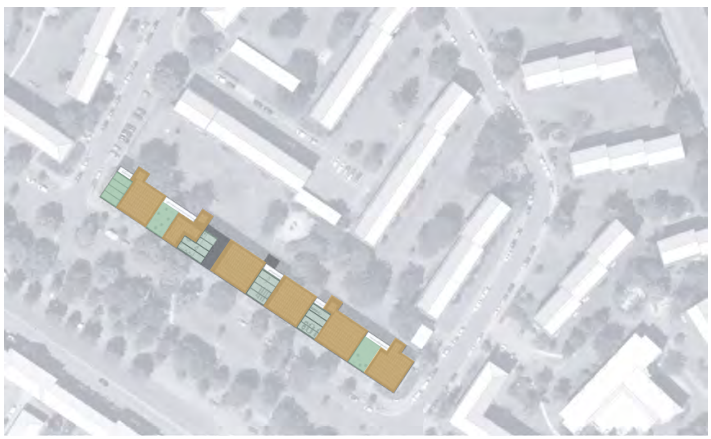


Figure 6 – Site Plan of the addition of storeys

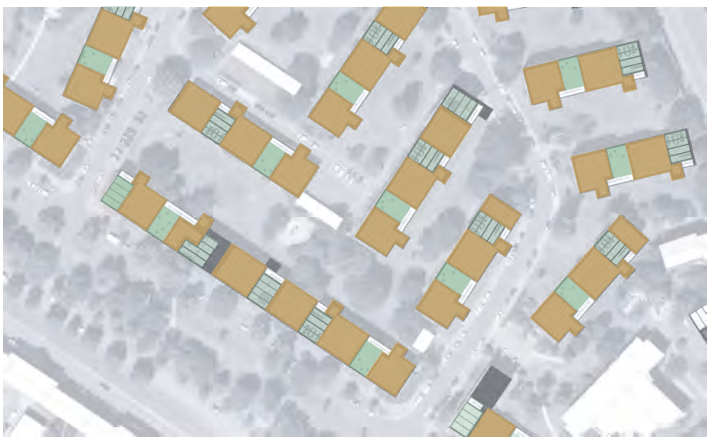


Figure 7 – Site Plan of the quarter / future vision

2.1.3 The architecture

Our addition of storeys puts the „crown“ on the existing building by using asymmetrical, low-pitched, gable roofs. The longer of the two roof areas, with a twelve-degree pitch, faces southeast and is equipped with PVT collectors for energy generation. Green zones, which can be used as outdoor areas or greenhouses, are integrated into the roof areas facing north.

The roofs cover two storeys of room modules. Each module arrives at the building site prefabricated, which means that the permanently installed interior fittings were already assembled in advance. This degree of prefabrication makes it possible to reduce both construction time and the overall structural load. The resulting decreased construction load also benefits the residents of the existing building and the neighbourhood.

Figure 8 – Rendering of the addition / Street Side

Figure 9 – Rendering of the addition / Garden Side

The addition of storeys stands out clearly, because it “protrudes” beyond the existing structure, reinforcing an obvious horizontal separation between the ‘old’ and the ‘new’. The generous fenestration on the street side of the addition of storeys contrasts with the smaller perforated windows of the existing façade, whereas the newly renovated fenestration of the existing building has been redesigned to maximize the incidence of light entering the lower story apartments.

In our design, we see the PV systems as an integral part of the architecture. To generate as much PV area as possible, the entire south-west façade of the existing building and the addition of storeys will also have a PV façade. The curtain-type, rear-ventilated façade elements characterize the design of the existing renovation with their asymmetrically seamed pattern. They serve as an insulating layer, house photovoltaic technology, and have integrated façade heating. One hundred percent of the required energy balance demanded by the addition of storeys is to be covered by renewable energies from the roof and façade PV units. Furthermore, the entire building is to be raised to a plus-energy level, which includes supplying the existing building storeys throughout the entire life cycle. Using the respective “levelup” app to control the system, each resident can monitor their electricity and water consumption and visualize the solar yield of the building‘s solar panels. An anonymized ranking of residents according to average values is intended at triggering the reconsideration of electricity consumption.

The addition of storeys, and the new roofscape above them, project slightly beyond the façade of the existing building which faces the common lawn area to the northeast. A steel „exoskeleton“ is constructed on this side of the building in order to carry the load of new staircases, lifts, and balconies that are constructed in front existing staircase cores on this side of the building. The new staircases and lifts ensure that a vast majority of the existing building, including the addition of storeys and the roof terraces, can be accessed without barriers.

Arcades are to be suspended in the exoskeleton at the level of the addition of storeys, which ensure horizontal access for all residents along the entire length of the building. In addition, the exoskeleton structure creates large-format balconies for the residents living in the existing flats. Because this is the shady side of the building, the balconies need to be offset from one another in order to catch sufficient sun light, which also adds value to the existing flats. On this side of the building, the new addition of storeys, the existing building, and the stair and lift towers visually merge into a single entity with aid of the greenery planted in conjunction with the steel exoskeleton.

The design aims to respond to the needs of the residents with innovative, economical, and small floor plans from which flexible architectural solutions can be developed. Diverse communal areas, a wide variety of green spaces, and attractive contemporary architecture represent a significant enhancement. Communal spaces result from the surplus areas that the grid brings with it, which means that they are always located near the staircases. All building residents are allowed to use these common spaces, which are intended to strengthen a sense of community and promote the connection between inhabitants. These communal spaces, some of which have two-story high fenestration, create visual connections between the storeys. By offering multifunctional spaces and communal roof areas, the building has the potential to become a new neighbourhood social hub.
The flats in the addition of storeys are composed of two or four modules. This creates average flat sizes between 77.9m2 and 36.7m2. This offers different floor plan sizes, which provides the neighbourhood with a balanced number of small living spaces, for different constellations of people. Our goal is that everyone should be able to live in our addition of storeys, whether it be small families, pensioners, students, as well as physically impaired people. Accessibility offers many people new perspectives, and the interior spaces can also be adapted to their needs. The bathrooms and kitchens are arranged in such a way that their position utilizes pre-existing utility risers. This way, pipe lengths and shafts can be kept to a minimum. Separate storage rooms are provided for each flat on each floor, as there are no common basement or attic compartments available to the residents of the addition of storeys.

Greening plays a central role both inside our building and outside. Green roof landscapes are created that invite residents to linger and sunbathe, and communal areas can be used as „green city oases“, and urban farming can also be practiced by all residents. The extensive fenestration of the communal areas, and the green areas at the interior, function as greenhouses that can be used all year round. The aim is to create pleasant recreational areas with a connection to nature, for relaxation and togetherness. The greenery, which is a main component of the design, takes up large areas of the roofscape, and extends down the north-east façade side covering much of the exoskeleton, the stair towers and balconies. The “hanging gardens” on this side of the building extend down and meet up with the lawn and garden area. Lush greenery on roofs and façades also creates a healthy microclimate and increases biodiversity in the city. Our new building renovation and addition of storeys does not seal more undeveloped green spaces, but returns green spaces back to the city.

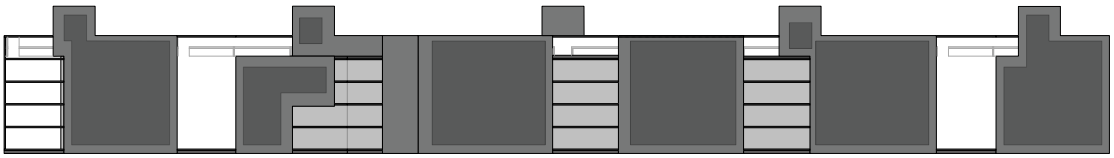


Figure 10 – Roof Plan / M 1:1000

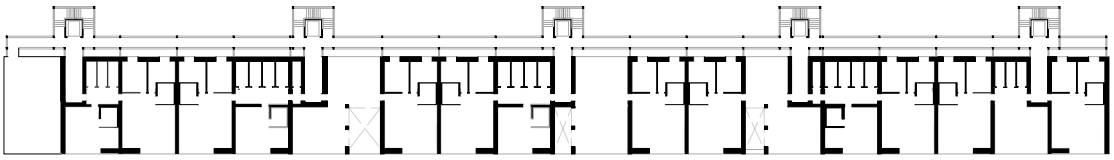


Figure 11 – Floor Plan Level 2 / M 1:1000

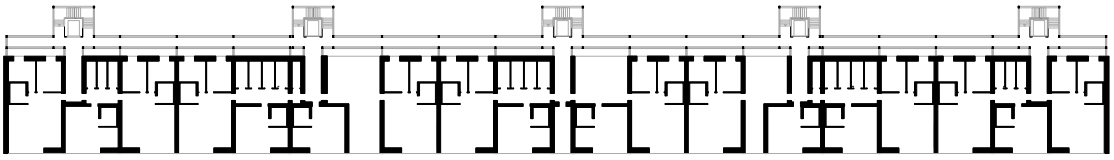


Figure 12 – Floor Plan Level 1 / M 1:1000

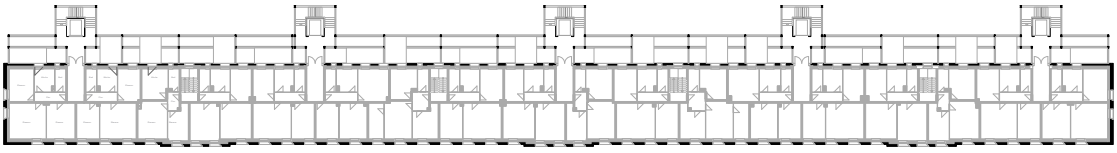


Figure 13 – Floor Plan Existing Building / M 1:1000

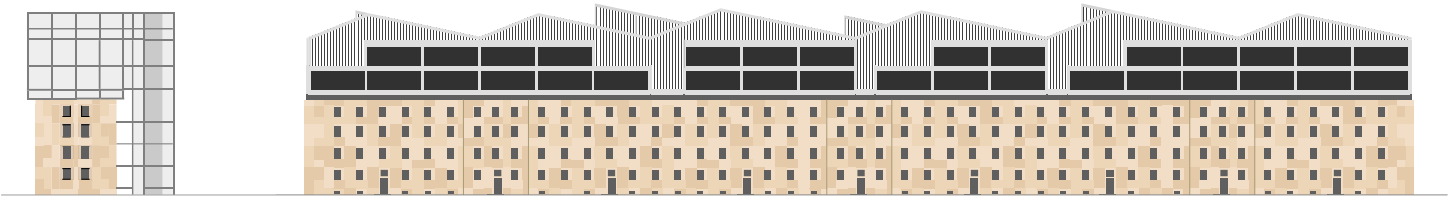


Figure 14 – Building Elevation / South-East + South-West / M 1:1000

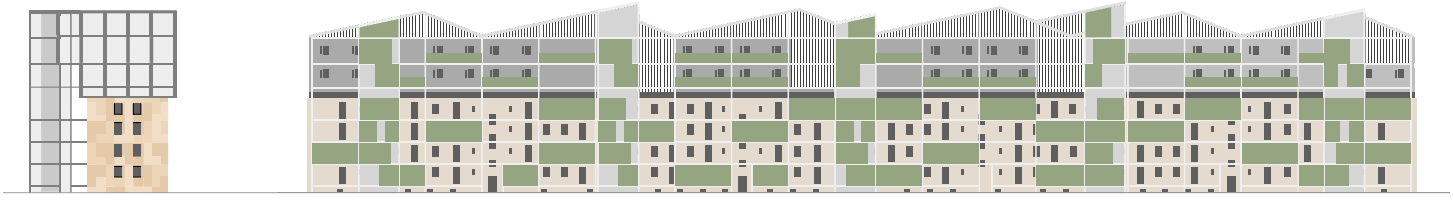


Figure 15 – Building Elevation / North-West + North-East / M 1:1000

2.1.4 Constructive solutions

The existing building serves as the basis for our addition of storeys. One of the most important factors in the design of additions to existing buildings are the added loads that are introduced onto the existing structure with the new building volume. The maximum load depends on the total mass of the building. If the permissible loads are significantly exceeded, additional foundation measures are required. In the case of our addition of storeys, several load transfer scenarios were already examined during the planning period. In the final stage, the structural engineers decided to transfer loads of the addition of storeys via the existing structure and not via an exoskeleton, as this would require an enormous amount of material for the implementation. In addition, this does not meet the requirements of our sustainability assessment and the economic efficiency for the project. The bracing is accomplished via the existing load-bearing exterior and interior walls. The load distribution level between the addition above and the existing building consists of hardwood, service class 2 beams.
The preliminary dimensioning results in beech-wood glulam beams dimensioned at 30/76 centimetres. These span from the outer walls as 2-span girders, over the load-bearing centre wall and are positioned exactly under the addition, which means that all addition of storey modules lie directly on top of the load distribution beams of the intermediate level. For additional load distribution support, extensions are provided for further load distribution.
Horizontally, the module joints always consist of two solid wood walls and an intermediate joint with mineral insulation. Similarly in the vertical, the ceiling of one module and a floor of the module above always form a two-layer ceiling package. This decoupling enables us to guarantee a high level of acoustic insulation. The flat roof, which forms the uppermost finish, is executed in the same way.

The walls of the modules are made of stacked board elements covered with diagonal formwork. The diagonal formwork is fastened with innovative wooden nails, which makes the wall construction very easy to dismantle and recycle. The ceilings and floors of the room cells are manufactured as hollow box elements. The great advantage of the box girder elements is the large free span length with low material input. In addition, cables and pipes can be laid in the hollow spaces, before the intermediate space is filled with shredded tiles, which are to be obtained from the demolition of the existing roof, and will function as addition acoustic insulation. The ceiling construction spans the 7.45 m long modules freely and thus allows both a free floor plan arrangement and a flexible façade design. The façade structure on the street side (southwest) is divided into thirds for each module – two thirds are open with a sliding window, and one third is covered with an opaque PV element solid.

Meeting the high fire protection requirements of building class 5 required by the Design Challenge, means that the walls have to be encapsulated, which is accomplished with two layers of twenty-two millimetre thick clay building boards. On the contrary, the HDU's fire protection requirement has been reduced to 30 minutes. Therefore, the thickness of the cladding on the HDU can also be reduced to two times sixteen millimetres for reasons of resource conservation. The ceilings are exclusively self-supporting and designed to be fire retardant. The floors of the modules carry and transfer the load , and like the ceilings, are made of hollow box elements. The roof surface of our addition of storeys is fitted with trusses that support the sheet metal roof with the PVT collectors and the fenestrated roof of the common rooms / greenhouses. The trusses and their foundation points always lie on the axes of the modular grid, which means that the loads are transferred down exactly through the load-bearing parts of the module wall. Wind trusses brace the entire roof area.

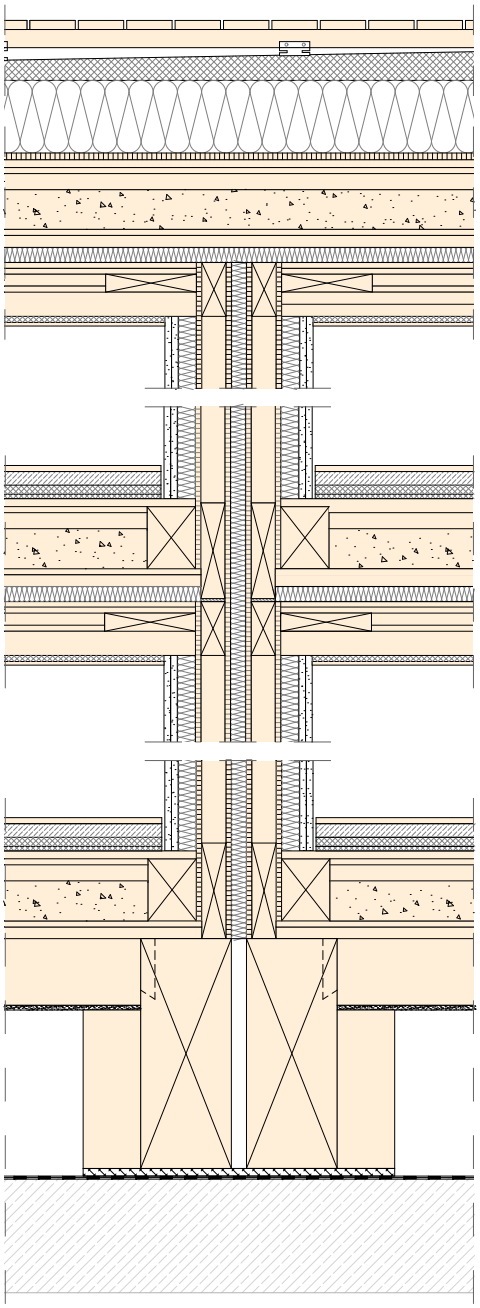


Figure 16 – Vertical Section Module Structure / M 1:25

Besides the addition of storeys, the entire existing building will be upgraded to meet state-of-the-art energy compliancy, which is technically achieved and visually complemented by a fully renovated façade in modular timber construction. The rear-ventilated, curtain-wall façade elements serve as an insulating layer and house the photovoltaic technology and a façade heating system. These technical elements encircle window systems but are physical separated or 'decoupled' from them using fire stops in the air layer. Decoupling serves both fire protection purposes and to avoid thermal bridges. The PV modules are attached using a rail mounting system that is fixed to the battens. In the lower area of the façade, steel channels are planned to allow cable routing for the façade heating and the photovoltaic modules to run within the façade elements. Windows will be preinstalled in the façade elements during prefabrication. It should also be noted here that additional sun protection measures on the existing building will not be need, because, according to our calculations, the solar gain coefficient is 0.183, thus below the permissible value of 0.265.

The PV façade is located on the southwest and southeast surfaces of the building. On the north-west façade, we are working with the same modular timber construction, but here the façade is planned as a three-layer panel. In front of this façade, there is also a steel structure that connects the stairwells and lifts to the building. Five of the existing staircases are moved to the outside and thus link the existing building and the addition of storeys. The stair flights run around the lift core and are made of steel for load-bearing, structural engineering, and visual reasons. The stair towers are not part of the thermal envelope and are therefore to be regarded as an exterior spaces. The balconies and arcades were included in the structural calculations of the steel structure. Due to the low construction height, the door thresholds leading into the building can be made barrier-free.

To comply with the Cradle to Cradle® (C2C) principle, we have attempted to minimize the proportion of grey energy wherever legal regulations allow. For example, existing solid and structural timber, and roof tiles, are to be recycled and used in the construction of the existing building. The component structure of the walls, ceilings, and roofs are easily separable and thus recyclable.

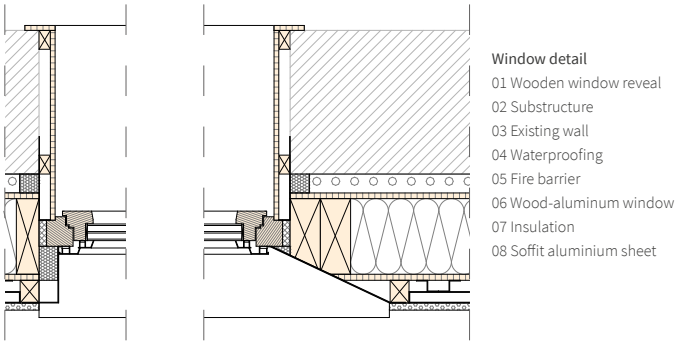


Figure 17 – Horizontal Section Window Detail / M 1:20

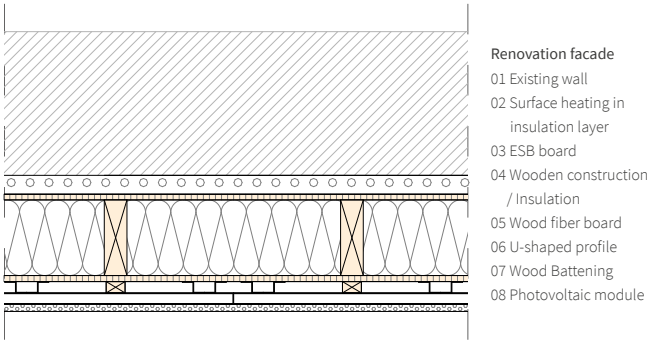


Figure 18 – Horizontal Section Renovation Facade / M 1:20

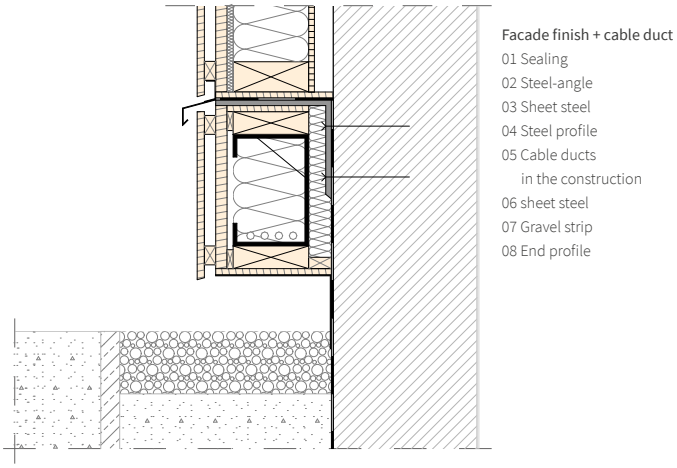


Figure 19 – Vertical Section Renovation Facade / M 1:20

3. The House Demonstration Unit (HDU)

3.1 Architecture Concept

In the architectural concept of the „levelup“ system and thus also of the HDU, we tried to find a balance of the competition themes: among others, maximum use of solar energy, building greening, sustainable and recyclable materials, flexibility, but also feasibility and affordability. This weighing process is reflected in our HDU. After the competition, our HDU will be used permanently on the campus of the Rosenheim University of Applied Sciences as a day-care centre and family office. For this reason, we also placed special emphasis on additional assembly and disassembly and maximum durability.
DC to HDU - adaptations to the Wuppertal location and the competition specifications.
The HDU shows a representative section of our „levelup“ system or the addition to our Design Challenge (DC). A barrier-free residential unit is built from the 2nd storey of the DC and the roofscape above with the integration of solar technology. In addition to the ground floor flat, the upper floor has two exemplary community uses, the greenhouse and the roof terrace, which are available for the social interaction of the residents.
Due to the competition conditions and our location on the Solar Campus in Wuppertal, adjustments had to be made compared to the DC. The roof orientation of the HDU is rotated by 180° to align the roof PVT system with the sun according to the location. The flat is shortened from 4 modules to 3 modules and the louvre façade and pitched roof is set back by one module width to remain within the solar envelope. This results in changes to both the external appearance and internal structure of the HDU compared to the DC. However, the basic principle remains the same.

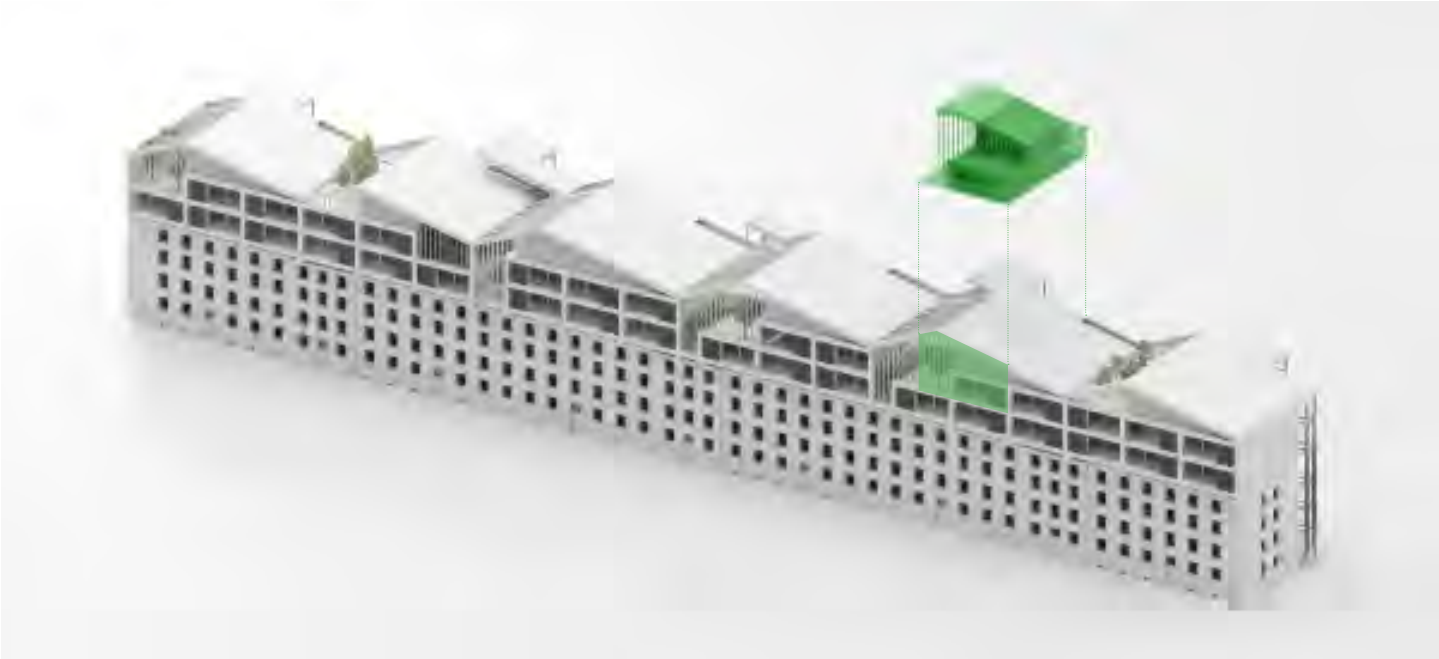


Figure 20 – Section of the HDU from the Design Challenge of the addition of storeys.

The HDU is accessed via a ramp on the „main street“. The HDU is located on a raised wooden platform for barrier-free access. On the ground floor, one flat is shown as an example. Since we had to shorten the flat from 4 to 3 modules compared to the DC, the interior has changed compared to the floor plan from the DC. The bathroom, for example, is on the north façade and not inside as in the DC. For the competition, we decided on a barrier-free flat with a very open floor plan. This can be easily viewed by many visitors, even under corona conditions, and can also be used later for our subsequent use as a day-care centre and family office. The free space without load-bearing walls and supports can be freely furnished and redesigned. Next to the large room with a kitchen, dining, living and working there is a barrier-free bathroom and a barrier-free bedroom. Both can be adapted for wheelchair use with simple hand movements. The goal is to create living spaces for all people, even those with physical limitations.

The exit from the residential unit (public tour) is via a second door in the southwest. Visitors reach the upper floor via a staircase. In addition, we offer barrier-free access via a lift on the northeast side. It is important to us that the entire HDU is barrier-free for all audiences to experience independently.
Our communal uses - greenhouse and roof terrace - and a technical room are located on the upper floor. The development of the upper floor represents an architectural deviation from the DC. This is due to the competition. In the DC, the vertical access is integrated into the scaffolding structure on the garden side. Due to the restrictions imposed by the Solar Envelope, so that the neighbouring buildings in the competition are not shaded, the staircase is located on the south-west façade of the building and the lift under the slatted screen in the north-east.

The residential unit of the HDU consists of three wooden modules with dimensions length of 7.50 metres x width of 2.95 metres X height of 3.10 metres. The three modules are prefabricated completely in Rosenheim and can be brought to the construction site - in the competition to Wuppertal - by lorry. Due to the maximum possible degree of prefabrication, our „Plug and Play“ system can be erected in Wuppertal in a very short time. We have taken advantage of the maximum transport widths and heights so that we can enable a sensible and flexible floor plan design, integrate a barrier-free bathroom and ensure a clear room height that is pleasant for the users. Due to the wide span of the modules of 7.50 m on the main façades, the façade openings can also be freely divided according to the uses behind them. This gives the „levelup“ system a great deal of design freedom despite a rigid modular system.

Figure 21 – Perspective from the east. Here you can see the ramp & entrance zone

Figure 22 - Isomtry of the HDU with the roof terrace and the Greenhouse.

The room modules consist of solid wooden walls, which are covered with a wooden insulation façade on the outside and clay building boards on the inside. The wooden walls made of spruce consist of upright squared timbers and diagonal boarding on both sides. They are fastened without glue, purely mechanically with beechwood nails, an invention of the TH Rosenheim together with the Beck company. The wooden nails not only have a lower environmental impact during production but also allow for significantly simplified deconstruction at the end of the life cycle. Wooden nails are also used for fastening the façade. The clay building boards are applied directly to the solid wood walls without an installation level and finished with pigmented clay plaster. In this way, a maximum possible thermal mass can be activated, despite a lightweight timber construction. We hope this will have a buffer effect and a positive influence on the summer thermal insulation of our HDU.

A fourth, smaller module contains a large part of the building services. This technology module can also be completely pre-installed. It is positioned next to the bathroom module and thus also enables a very quick connection. The module is integrated into the design under the staircase to the upper floor.
The components that require little or no pre-installation are delivered to the construction site in large elements to save space for transport. The maximum transport dimensions are fully utilised. This includes, for example, the façades, which can be quickly installed in their entire length as an element after the modules have been erected. The insulated floor and ceiling elements are also transported separately and connected to the room modules at the construction site. This separation of room module and insulation elements allows maximum clear room dimensions into the module interior while at the same time ensuring transportability.

To obtain a solar plus energy building, the energy demand of the building must be minimised in any case. The thermal envelope is therefore built in an energetically, but also economically optimal range, following the passive house standard. The simplest possible constructions and materials are used, which are affordable as well as sustainable and recyclable.

The insulation material used is standard softwood fibre made of sustainable, certified material. This results in wall and ceiling thicknesses of about 55 cm to achieve a U-value of approx. 0.1 W/m^{2}K. Only on the roof terrace, due to the hygienic requirements, the limited height and the insensitivity for the planned permanent subsequent use, must a more moisture-insensitive insulation material with lower thermal conductivity be used. Here we use a rigid polyurethane foam that can be removed at the end of its life cycle and at least thermally recycled.
The windows have a Uw value of approx. 0.8 W/m^{2}K. The wood-aluminium frames take into account durability and ease of maintenance. We have also agreed with our client, the state housing association Siedlungswerk Nuremberg. Appropriate window frames are also used for subsidised housing construction due to their cost-effectiveness over the life cycle. After dismantling, aluminium and wood can be separated by type and recycled. Due to the extreme price increases of krypton gas in 2021 and 2022, we are not using triple glazing with krypton gas filling, as this trend will continue in future construction projects. Our glass partner Interpane and Fineoglass from ACG Glass Europe are sponsoring us with the latest vacuum hybrid glasses, a glass structure consisting of two float glass panes with a vacuum in the inter-pane space (SZR) and an additional attached pane with an inter-pane space of 12 mm argon gas filling. The Fineo HYBRID has a U-value of 0.4 W/m^{2}K. Thanks to the vacuum glass, thinner glass thicknesses than with triple insulating glazing can be realised with optimum U-values at the same time. The glass is installed in the HDU and also represents a forward-looking solution for refurbishment buildings, where the existing window frames can be retained and modernised with new glass.

Figure 23 – Perspective from the south with the stairs to the first floor.

Figure 24 – Isometry from the back of the HDU.

Of course, the solar energy supply plays a central role in a Solar Decathlon. The architectural concept of the DC is guided by maximum possible PV/PVT integration, both in the renovation façade and in the addition of new storeys. In addition to PV optimisation for renewable electricity generation, the second focus is on building-integrated greening to maximise climate resilience and biodiversity, among other benefits. Both ideas are exemplified on the two main façades of the HDU and the roof.

The southeast-facing main façade of the HDU, which faces the competition street, shows our solar façade with BIPV modules. This is also the street façade of the DC. The selected BIPV modules from Sunovation can be freely coloured. With the light-coloured modules, we accentuate the module frame to illustrate our modular design and construction principle. The dark BIPV modules, with the maximum possible efficiency, form a design unit with the window openings located in the frame. The façade and window division could be freely designed depending on the use behind them. At the rear of the building, in the case of the DC the garden façade, our scaffolding is attached, which in the case of the HDU includes access to the attic, but also serves as a climbing scaffold for our façade greening. The scaffolding cannot be built in wood in the DC for fire protection reasons, among other things, which is why we also build it in steel in the HDU. We use recycled steel for this, which consists of 100% recyclate and is produced with 100% renewable energy. The steel can be separated by type at the end of its life and recycled without loss. The walkable covering of the arcade consists of gratings. These allow good daylight penetration into the rooms below, the bathroom and the bedroom. To optimise the incidence of daylight and at the same time minimise the views from the ground floor through the arcade upwards to the visitors, gratings with slanted slats with a 45° angle are used.
On the sloping roof facing south-west, we integrate our PVT system above the technical room on the first floor and a transparent PV system above the greenhouse. The transparent PV system fulfils both the purpose of generating electricity and providing light and overheating protection for the greenhouse.

The greenhouse façade consists of an ETFE film. This was chosen instead of glass because of the low material requirements and cost optimisation. In front of the transparent façade, a wooden lamella screen is mounted. This is designed in the same way as the DC. In terms of design, it combines the free areas, i.e. the „buffer zones“ between the modules, and at the same time offers low-maintenance protection against overheating. All areas equipped with the louvre screen are communal areas that do not have strictly defined requirements for room temperatures, such as the greenhouses. In the HDU, the louvre screen has to be set back from the street façade, otherwise, it would not have fitted into the Solar Envelope. This intervention in turn makes it possible to represent a roof terrace in the HDU that exists in other areas of the DC.

A ventilated timber façade is installed on the remaining façades. A simple timber substructure, developed in analogy to normal metal agraffes systems, allows for the quick and easy maintenance of hanging and unhanging timber façades. Wooden boards could be hung, but at the HDU we decided to use silver fir triple-layer boards. These are installed very quickly in the competition and also show the façade idea on the existing DC building in the areas where no PV modules are attached. With its joint pattern, the panel division illustrates the modularity and construction of the HDU.
On the upper floor of the HDU, in addition to a technical room, are the greenhouse and the roof terrace. They exemplify two possible community uses from the DC. Here, both variants of roof greening and social interaction spaces for the residents - e.g. urban farming - are to be made tangible.

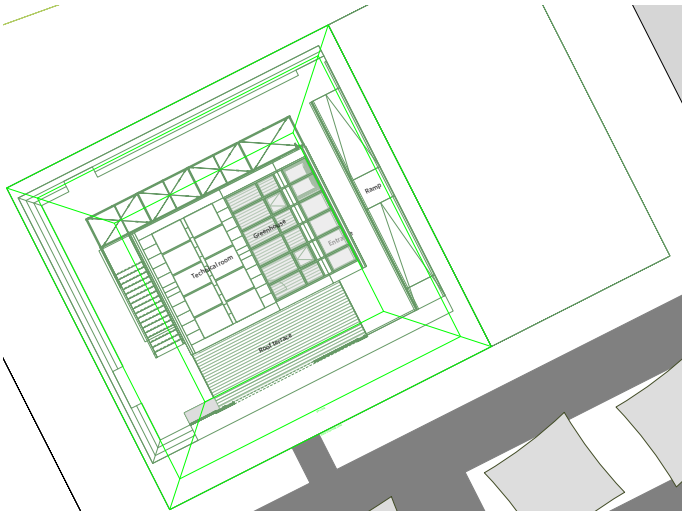


Figure 25 – HDU with the solar envelope

The building technology is integrated into the architecture of the HDU. In addition to the PV integration, the technical equipment is also integrated into the design. On the north-east façade, next to the main entrance, the lift for barrier-free access to the upper floor is integrated under the lamella screen on one side. On the other side of the main entrance is the charging station for our electric cargo bike. As sustainable mobility will be an important part of our future cities and buildings, we have positioned this prominently.
Under the stairs on the ground floor is our technology module, which can be connected to the technology in the bathroom and kitchen in the shortest possible way. On the upper floor under our PVT area, there is another technical room under the sloping roof. This area cannot be used for visitor traffic due to the low room height and is therefore ideal for the technology. This is where our rainwater and service water systems are housed. The water circuits on the upper floor and the other technology on the ground floor can be viewed by visitors through windows. The wooden platform built around the HDU is also used to integrate the technology. Among other things, freshwater tanks are housed here.

All in all, an attempt was made to integrate as many uses and functions as possible in the House Demonstration Unit and to make multiple uses of all rooms and areas.

3.2 Interior design

Open, bright, barrier-free floor plan for two people, with a large bathroom and small but highly functional separate bedroom with an integrated workstation in the partition wall designed as a built-in cupboard. The fold-out, space-saving second workstation in the living room makes the flat entirely suitable for a home office for both residents. All three rooms have been designed barrier-free in the floor plan layout by adhering to the 150 cm diameter at the main functional points, 90 cm clear door width and accessibility of the two-room access sliding doors for wheelchair users. The sliding door fittings provided for this purpose by Häfele („Slido D-Line11 80L“) can be retrofitted with relatively inexpensive electric drives in the track system is required for disabled persons.

All built-in furniture such as the kitchen unit, kitchen island, wall cupboards and wooden partitions, and the complete bathroom with its removable wall panelling in the wooden modules, including all cable routing, are delivered to the construction site ready to plug in (plug and play). The module connection joints on the wall and floor also serve as installation ducts, which remain easily accessible for later cable retrofitting via magnetic locks. Together with the electrifiable skirting boards, this ensures future-proof cable routing without slot tapping. The socket boxes on these skirtings can be repositioned or extended with little effort according to the tenants‘ wishes in the event of a change of tenants.

Floor
For high-quality rented housing, the floor is made of natural wood, ash-click parquet flooring as CO2 storage (Series 4000 by Haro), the surface sealed with food-safe bio-wax suitable for the property, with a space-saving, loosely inserted cork underlay layer underneath so that the required impact sound insulation level of the flat ceiling is achieved despite the lightweight container ceiling construction. In case of a low rental price level, the version as click laminate is provided - both flooring variants are recyclable in class 2.

Ceiling
The ceiling cladding by Lingnotrend is wholly made of acoustically effective mouldings. Silver fir strips will probably replace Nordic spruce in our latitudes in the long term due to their better climate resilience (deep-rooted trees) in forestry. The acoustic absorber layer behind them, necessary for pleasant room acoustics, is made of regionally produced wood fibre boards.

Wall
Internal cladding in 3 x 16 mm clay building boards with flax reinforcement fabric from Claytec, finished with Q3 plaster and painted with breathable system-compliant white coloured fine plaster with straw additive, open-pored. The third additional layer of clay building boards is intended to increase the storage mass for thermal insulation in summer. The window is also revealed in silver fir three-layer boards. Both materials stand for regional material extraction and processing, as with the ceiling cladding.

Figure 26 – Living room

Fitted wardrobes and furniture

In addition to the main goals of high flexibility and multi-functionality, the restriction to as few as possible but durable furniture and interior finishing materials is at the top of the HDU's list: „If all furniture, doors and interior fittings worldwide were made of solid wood, we would already have no forests left". The most effective possible use is made of directly coated white chipboard „Beyond" from Suisse Krone. This is characterised by an above-average proportion of recycled wood, a low-pollutant, 90% bio-based adhesive mixture (only 0.05 ppm formaldehyde emission) and a take-back guarantee from Swiss-Krono in accordance with EoL. When selecting the metal fittings, care was taken to ensure that all fitting components could be separated by type as far as possible.

The dividing wall cabinet between the living room and the bedroom is equipped on both sides with three extendable linen roll containers in the lower area: In the event of the use by wheelchair users, these are placed in a different position and thus enable the necessary accessibility, e.g. to make better use of the upper clothes rail that can be swung out for wheelchair users or the built-in writing desk in the bedroom.

Figure 27 – Living room and the kitchen

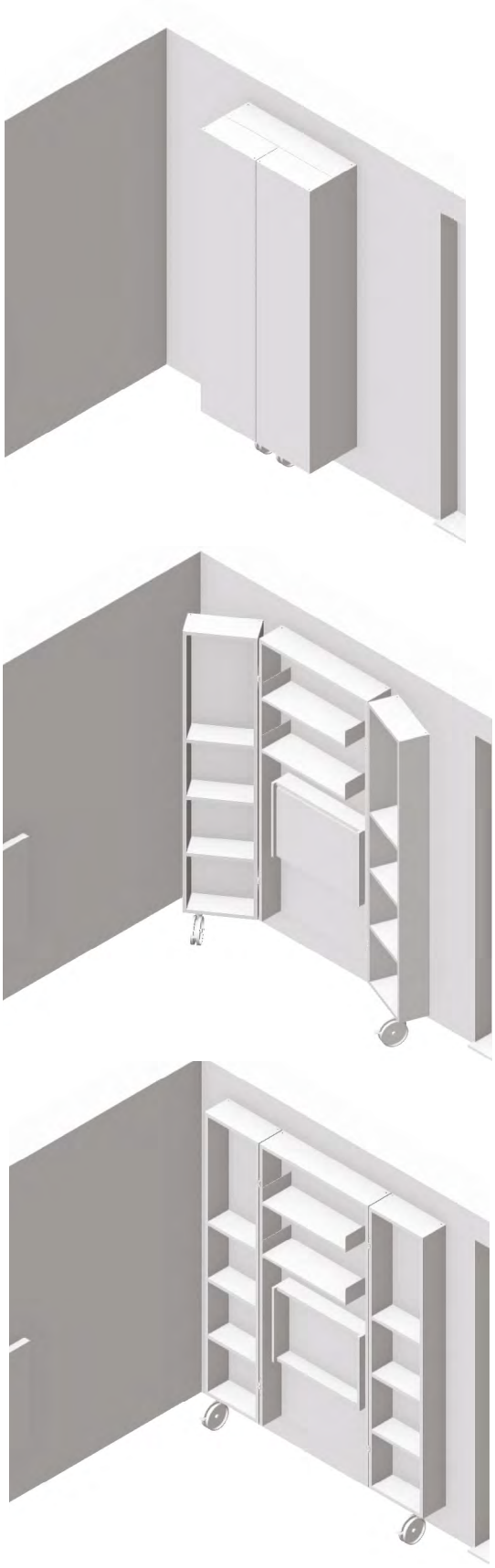


Figure 28 – diving wall cabinet between the living room and the bedroom

Thanks to the base cabinets, the kitchen unit and free-standing kitchen island are also designed to be accessible by wheelchair. The free-standing kitchen island can also be individually adjusted to the standing or sitting height of the residents and wheelchair users using lifting motors. Decorative recycled glass from Magma was chosen for the worktops of the kitchen unit and kitchen island, as well as the door panels of the sliding doors.
The solid wood ash extending table adjoining the kitchen island is designed in the traditional, reliable craftsman's manner with only a light „accordion" tabletop instead of today's elaborate metal extending mechanism. It can be used variably for up to eight people.

The solid ash bed in the bedroom can be pushed together from a width of 70 cm to 140 cm to provide sufficient space for the writing desk that can be pulled out of the wall cupboard if the bedroom is used as a home office. Thus, despite the small bedroom floor space of less than 10 m² for the 2-person household, a second, fully-fledged home office space can be provided here. The area in front of the washing machine cabinet between the sliding glass doors is also wheelchair-accessible with a width of 150 cm.

Figure 29 – Living room with the couch and the home office space

The living area includes a 12-piece modular couch that can be used or converted from all four sides depending on the living situation. Individually pluggable backrests, fold-out tops, partly upholstered, partly as a shelf in solid wood, with storage space underneath, allow great design versatility for the user. When the plug-in backrests are pulled out, the sofa landscape can be used as a guest double bed.
The 12 storage boxes are made of Kronosuiss „Beyond" chipboard, with Sonnhaus „oceansafe" upholstery fabric (100% biodegradable) and upholstery made of regionally produced sheep's wool fibre (Lavalan fibre filling).

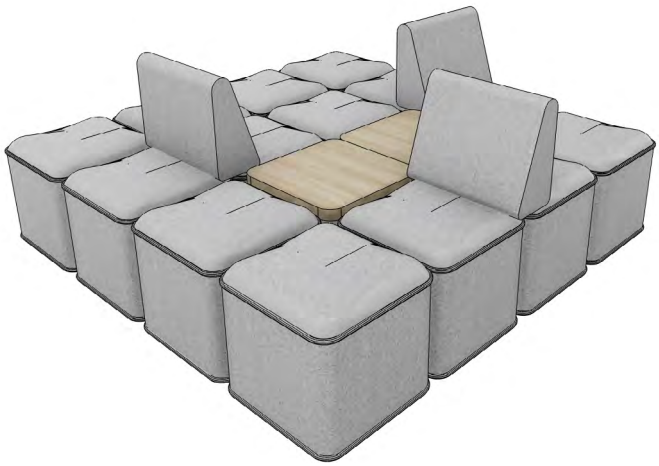


Figure 31 – 12-piece modular couch

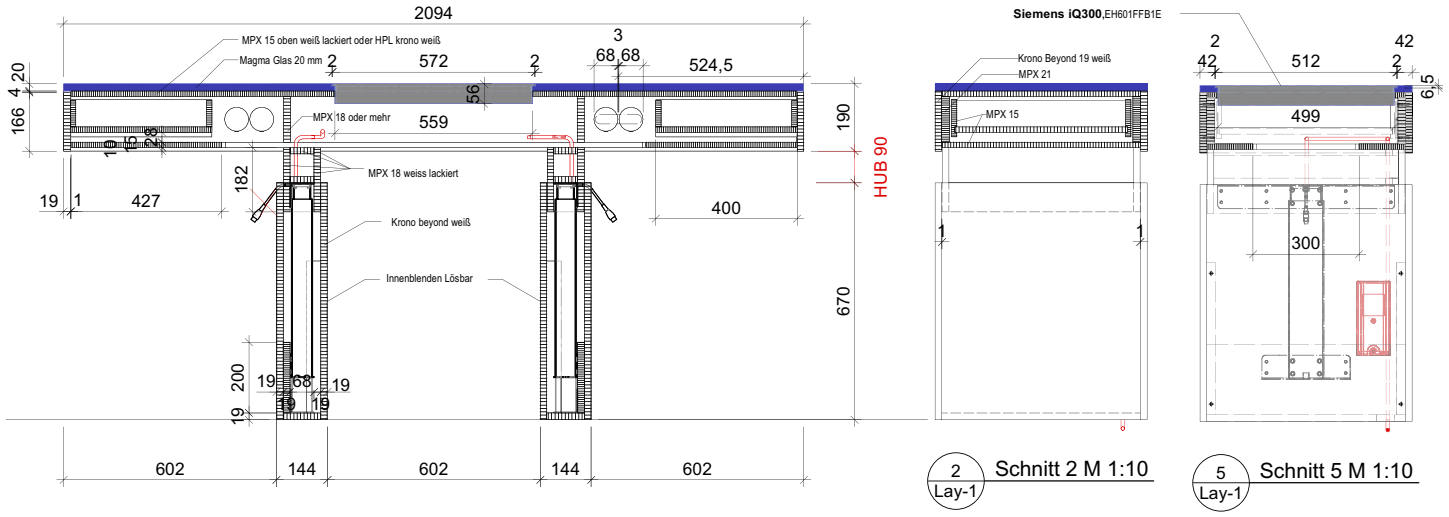


Figure 30 – Technical drawing of the kitchen island

Bathroom

Instead of placing completely pre-installed, internally closed surface-finished sanitary boxes with a uniform ground plan in the building, as is usual in multi-storey housing construction, which has to be extensively converted and re-equipped when the state of health of the residents changes, our modular bathroom system goes one step further:

At its core, the wooden post and beam system consists of CNC-milled beech LVL posts, with waterproof wall cladding made of Resysta panels that can be easily dismantled even after years of use. Because these panels can be easily dismantled from the room side, the complete piping and installation can be accessed at any time without great effort, which greatly simplifies maintenance or subsequent changes to the piping during operation. At the same time, the reversible and 100% recyclable sealing profiles (CEG-RAN®, REACH compliant (EU Chemicals Regulation) and a loosely inserted, preformed and recyclable sealing sheet element under the large-area Resysta floor panels guarantee the normatively required principle of double sealing against water penetration into the building structure - without the previously common bonding of the sealing sheets with underlying materials to form composite materials that can no longer be separated by type.

This LVL stud system with all pipe penetrations and connecting fittings already pre-milled in the factory can react flexibly as a modular „planning kit“ with a high degree of industrial prefabrication and consequently a low proportion of site finishing, even in existing flats, to the most varied floor plans with their respective bathroom functions. Another advantage is that the stud system consists of only a few components such as beech LVL studs, the water-resistant Resysta panels made of rice straw for the floor and wall, and non-glued mechanical connecting fittings and sealing components. The shower tray support is made of recycled PET (Saxoboard PET ECO) and the loosely inserted sealing sheet element is made of recyclable PVC. This means that all bathroom materials can be cleanly separated according to EoL and either reused for new or modified bathroom situations or recycled.

The adherence to the 150 cm turning circle in the floor plan, the accessible washbasin and floor-level shower tray, and the possibility of retrofitting heavy-duty grab rails, bars or folding seats on all wall surfaces without great effort enable full accessibility.

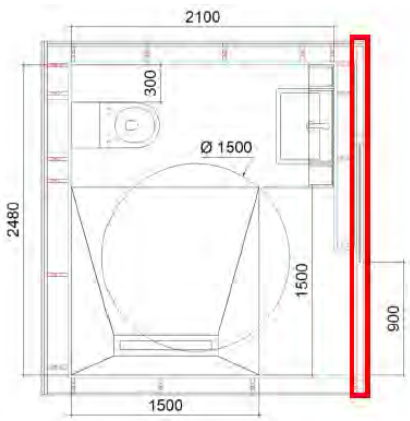


Figure 32 – Floor Plan of the bath

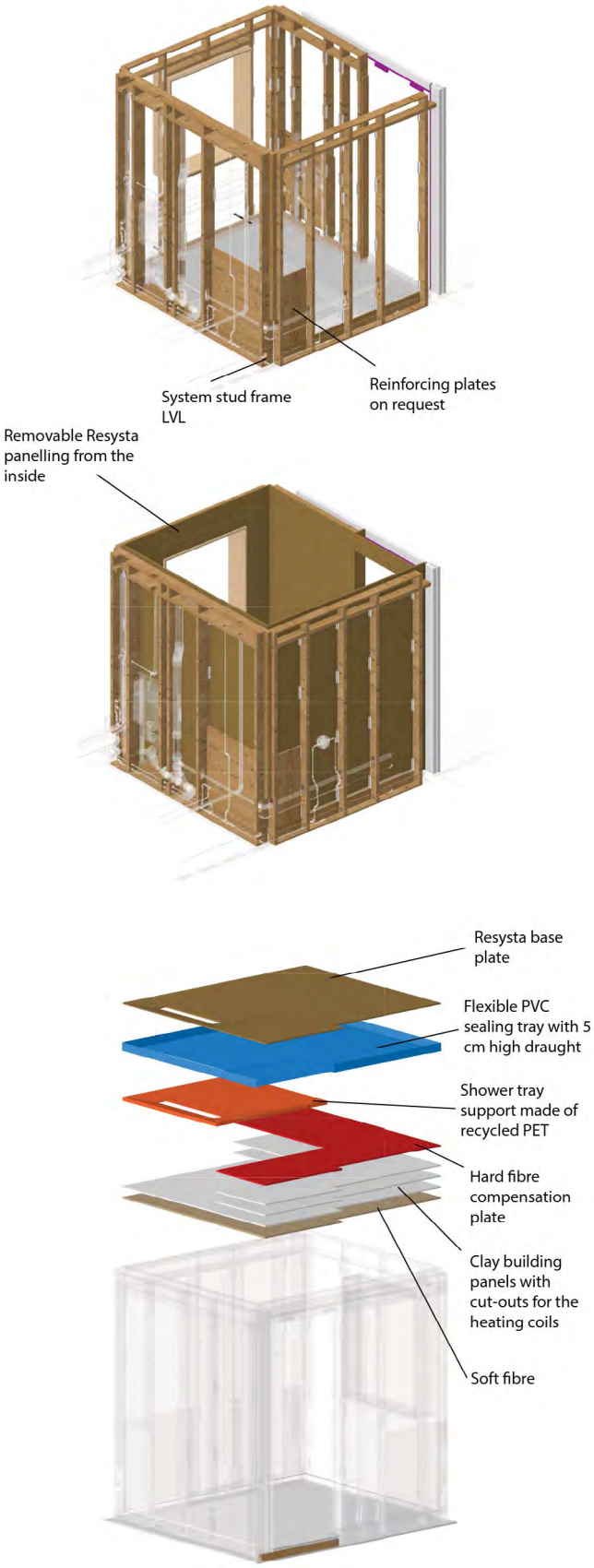


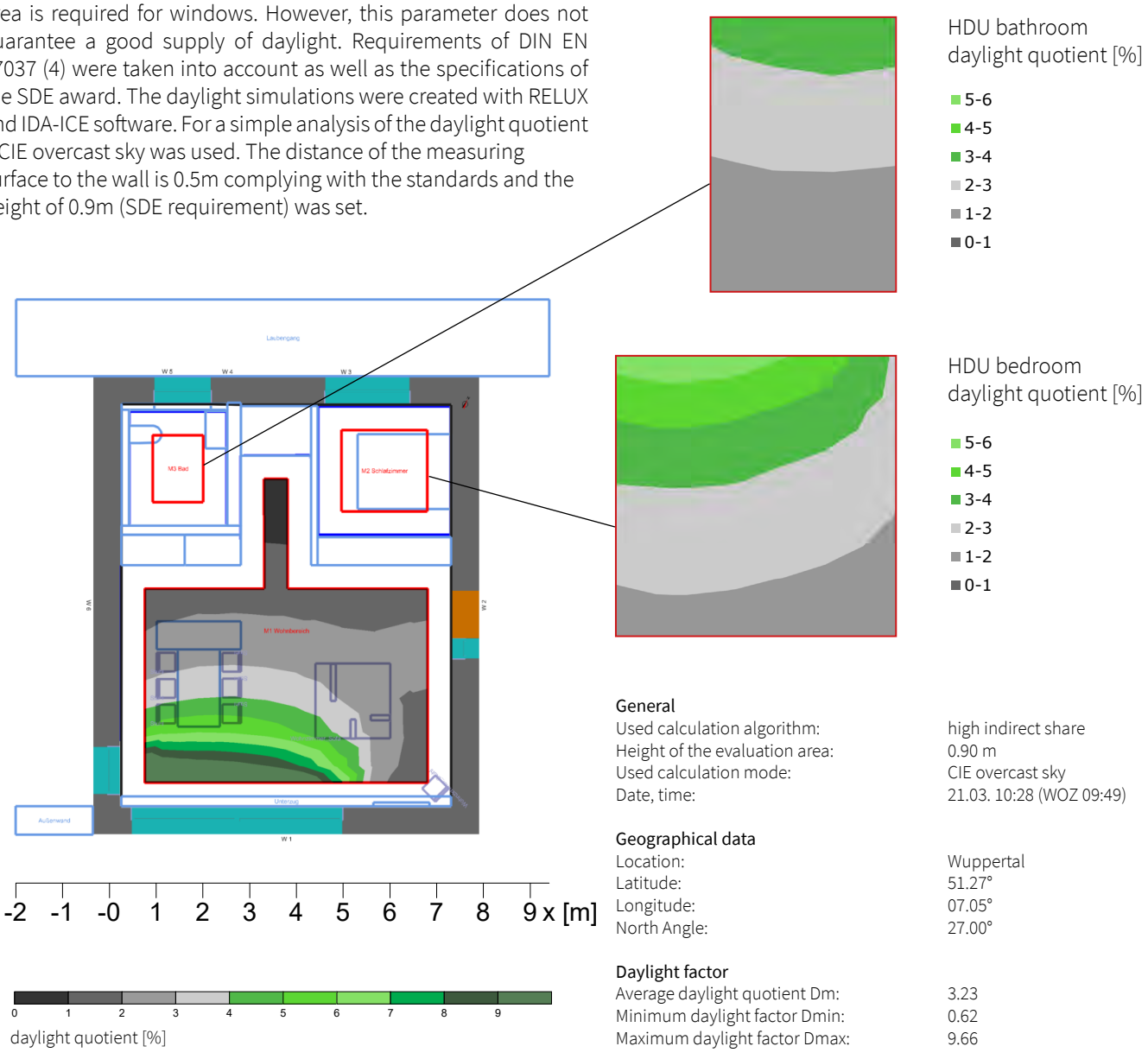
Figure 33 – Bath module

3.3 Lighting Design

3.3.1 Natural lighting concept

The daylight situation was considered holistically as part of an integral planning process. Comfort, energy efficiency and consideration of the indoor climate were given top priority. The focus of daylight planning is on people, their well-being and health. The circadian rhythm, our „inner clock“, is significantly influenced by light, because it determines the processes of sleep-wake phases, organ functions, hormone production, concentration phases and emotions in our body. (1) For these reasons, daylighting has been a significant basis of architectural planning. Laws and standards were used to analyze the planning of daylighting. According to state building regulations in Bavaria (2) as well as North Rhine-Westphalia (3), an opening of at least one eighth of the net floor area is required for windows. However, this parameter does not guarantee a good supply of daylight. Requirements of DIN EN 17037 (4) were taken into account as well as the specifications of the SDE award. The daylight simulations were created with RELUX and IDA-ICE software. For a simple analysis of the daylight quotient a CIE overcast sky was used. The distance of the measuring surface to the wall is 0.5m complying with the standards and the height of 0.9m (SDE requirement) was set.

Numerous optimizations were carried out in coordination with the thermal simulation and the architecture. The living area is supplied with sufficient daylight due to the large window faced south-west. As part of the optimization process, different degrees of reflection were checked for example, for the floor covering and the surfaces enclosing the room. On the north side, the construction and materiality of the pergola could be revised for the best possible daylight incidence. The minimum requirements of DIN EN 17037 are achieved, as are the requirements in the competition.
(More graphics see attachment.)



General

Used calculation algorithm:	high indirect share
Height of the evaluation area:	0.90 m
Used calculation mode:	CIE overcast sky
Date, time:	21.03. 10:28 (WOZ 09:49)

Geographical data

Location:	Wuppertal
Latitude:	51.27°
Longitude:	07.05°
North Angle:	27.00°

Daylight factor

Average daylight quotient Dm:	3.23
Minimum daylight factor Dmin:	0.62
Maximum daylight factor Dmax:	9.66

Figure 34 - HDU living area daylight quotient

3.3.2 Artificial lighting concept

The lighting of vertical and horizontal access areas in the exterior of the HDU follows a continuous principle and is based on only one linear luminaire type from InstaLighting. This is usually used in a handrail. Accordingly, all stairs and ramps with handrails are also equipped with it. This ensures sufficient brightness when using these areas. In the area of horizontal access, the principle of „light from the handrail“ is deviated from. In order to reduce the effort for cabling, the luminaires are placed all around the outer walls of the HDU. In order to also supply these areas with the prescribed amount of light across their entire width, the luminaires are placed at a significantly greater height. There is sufficient luminous flux in this type of luminaire for this purpose.
The light is characterised by an asymmetrical luminous intensity distribution curve that is excellently adapted to requirements. The luminaire is already very well glare-reduced in the longitudinal direction. For the atypical type of installation at a greater height on the façade, glare control in the transverse direction is achieved by a simple modification during installation. Overall, this ensures that no light falls into the extended surrounding area of the HDU, thus minimising the effects on animals and plants caused by nighttime lighting. For the subsequent use of the HDU at the Rosenheim site, presence detectors are planned in the façade area. The lighting solution is thus only raised to the specified brightness level when a person is detected. In phases without user interaction, the system provides only a reduced basic brightness with low luminous flux. This principle of „dynamic light“ is already being used in practice in the lighting of streets, cycle paths and footpaths (smart cities) and will become even more widespread in the future due to the energy-saving potentials that can be realised in this way.

In the area of the greenhouse, the design motiv of the light line is repeated in the area of its roof construction. In addition, battery-buffered portable lights allow individual lighting of the lounge area on the roof terrace.

Figure 35 – „Uma Soundlaterne“ table lamp also for the outdoor area

Trends in interior lighting clearly show the desire of users for individual lighting of their living environment. Lighting solutions are becoming smaller and often consist of more than one component per room. In addition, the increasingly widespread wireless protocols for controlling lighting components allow thinking in terms of lighting scenes.
However, the classic „ceiling outlet“ has lost none of its importance - on the contrary. Today‘s modern housing must offer more than just one ceiling outlet, which is usually located in the middle of the room. Within the scope of the project, a variety of floor plan and furnishing options were therefore examined and possible positions for recessed, surface-mounted or pendant luminaires were identified. At these points, a self-developed mounting box is permanently integrated into the ceiling, which can then be activated by the respective users as needed. The mounting box, which is fitted with a blind cover and is barely noticeable in the ceiling structure, is realised as a prototype in 3D printing. After removing the blind cover, a downlight for general lighting or a pendant luminaire for targeted lighting of a table, for example, can be mounted at this position. The electrical contact is ensured via a standardised GU10 socket. These electrified mounting boxes are sensibly pre-grouped according to their functional context in the building automation system. If the users have further requirements, this grouping can be easily adapted by a specialist company. The system implemented in the HDU avoids the subsequent drilling of ceilings and the often unsightly warping of cables. It allows users to create individual lighting solutions with little effort.

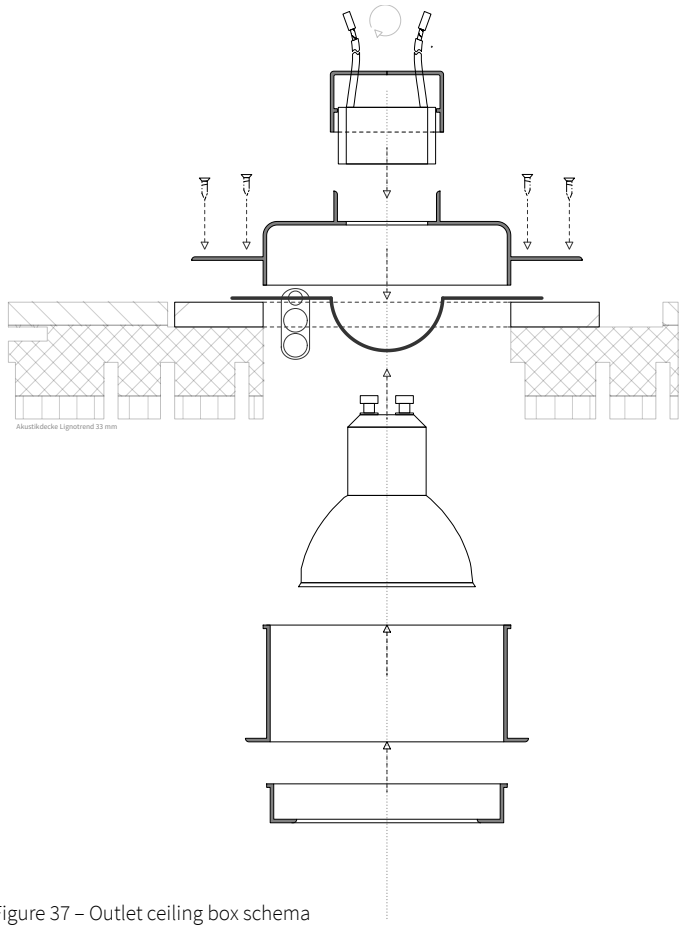


Figure 37 – Outlet ceiling box schema

The light sources and luminaires shown in the HDU are oriented towards the high-quality visual task in the area of living, cooking and dining. The downlights are equipped with GU10-based light sources from Soraa, which are characterised by the outstanding colour rendering properties (RA 95). When selecting additional luminaires, the team took sustainability and social aspects into account as additional criteria alongside pure lighting quality and atmospheric effect. This can be exemplified by the „Tripod Traditional Ship N°01 in Sail Fabric“ floor lamp with fully recyclable materials.

Figure 36 – „Tripod Traditional Ship N°01 in Sail Fabric“ floor lamp

Figure 38 – „Recycling Gas Bottles „Hanging Lamp FIRELIGHT silver“

3.4 Solar System Integration

3.4.1 Solar Aesthetic Integration

The new height of the building opens up new possibilities for the intensive use of solar energy. Therefore, all yielding solar surfaces are covered with solar modules, while greening is located on low yield areas to strengthen biodiversity in urban areas. To supply the building entirely with renewable energy, we also use the façade beside the roof for energy generation. Most of the usable space is on the façade, so it is covered with solar modules and thus significantly contrib-utes to the climate-neutral building stock. Building-integrated photovoltaics (BIPV) also finds a larger sales market due to falling prices. On the roof, we use high-performance photovoltaic-thermal collectors. The collectors not only gene-rate electricity at competitive prices but also generate heat. The removal of the heat during the day increases the efficiency of the modules. At night, the PVT modules can generate cooling through night-time radiant cooling.
Modules, inverters and installation prices have continued to fall, so more and more PV roofs are realised. Due to the differently oriented PV surfaces, the electric load profile is more harmoni-ous throughout the day. Therefore, smaller energy storage systems are needed than purely southern orientations, and the electrical grids are relieved. Since the costs for BIPV are still high, scaling effects play an essential role here. For this reason, the entire façade covers photo-voltaic modules. In addition to the PVT modules (1483 m^2) and BIPV (1746m^2), we also use semi-transparent PV modules (52 m^2) on the greenhouses located on the roof areas. These modules have a double benefit, as they provide shade and produce electricity. The intensive use of solar energy and the different technologies fit into the overall architectural picture and shape the concept with expressive and visionary architecture. The layout of the PV modules on the façade in particular makes the module grid on the extension visible.

3.4.2 Constructive Solution

The BIPV system is attached to the wooden battens with classic agraffe profiles. The bracket is then fixed directly to the façade. These are conventional systems that have proven themselves in practice. The PVT modules are mounted on a sheet metal roof with rails. The fastening is sim-ple and inexpensive to realise. The semi-transparent modules on the greenhouse are fixed be-tween the rafters with profiles, which represent an elegant form of fastening.

3.4.3 Additional Properties

In addition to the previously established pure PV modules, PVT modules are installed. These are a combination of PV modules for electricity generation and solar thermal collectors. This combi-nation allows the cooling of the modules to increase efficiency. At the same time, the PVT col-lectors serve as a heat source for heating and domestic hot water. A LowEx concept foresees a maximum flow temperature of 25°. A low temperature means that heat sources with low tem-peratures can be used. This allows high flexibility of the concept and, thus, good transferability to different locations. The heat is brought into a façade or underfloor heating system and pro-vides the conditioning of the building. Night-ti-me radiant cooling can also fill a water cold stor-age tank, which provides the necessary cooling in the apartments during the day. In the Design Challenge, however, not the entire roof is equipped with PVT collectors, as otherwise too much heat and cold would be generated. A large part, therefore, contains pure PV modules. The di-mensioning is based on the heating or cooling demand of the house.

Figure 39 – PV(T) areas at the HDU

3.4.4 Maintenance

PV modules have a significant advantage: they do not require extensive or frequent mainte-nance. A monitoring system monitors the PV systems and sends error messages to the operators in the event of problems. Cleaning the modules is usually unnecessary, as rain automatically washes the modules. Even during prolonged dry periods, cleaning is generally not necessary. Separate cleaning would only increase the water consumption unnecessarily, and the expected additional yield is not concerning the cleaning costs. Due to the intelligent interconnection of the modules and the monitoring, performance losses are reported immediately. The roof sur-faces are easily accessible for maintenance and servicing, and the façade modules can also be easily changed, as they are only connected to the façade via a rail. Visual inspections with drones and thermography help to notice cell breaks and claim warranty claims. PV modules come with performance guarantees of up to 25 years, depending on the manufacturer.

3.4.5 Economy of Installation

The economic viability of solar plants results in particular from scaling effects. In particular, module prices for PV(T) modules have fallen in recent years. The costs for the PVT modules (Du-alSun SPRING 375W) installed on the House Demonstration Unit amount to 8467 euros. The total installed power is 3750 W/m^2, of which only 3 kW are connected during the competition (size of 18,8 m^2). Modules with the highest degree of efficiency were chosen for the competi-tion phase. There are also semi-transparent PV modules on the roof of the greenhouse, but this is an expensive custom-made solution. On an area of 13.3 m^2, a 4 kW system was installed at a cost of 5190 euros. The building-integrated photovoltaic costs 13,509 euros for an installed ca-pacity of 4 kW. As can be seen, the costs for custom-made products and BIPV are very expensive and, at first look, not economical. For larger areas, the costs are significantly reduced, especially for our Design Challenge. If a high level of self-consumption is guaranteed, rapid amortisation is given. However, there are also costs for inverters, smart meters, installation and operating costs. The following table shows an overview of the three PV systems installed.

	PVT (roof-system)	Semi-transparent modules (roof)	BIPV (facade)
Power [W]	3750	1486	4000
Power per square metre [W/m2]	200	111	143
Total Costs [€]	8467	5190	13509
Costs per installed capacity [€/W]	2,25	3,5	3,3

36 Engineering & Construction Report

Table of contents

1. Design Challenge

a. Initial situation

Our existing building, erected in Nuremberg in 1933, consists of six floors: an unheated basement, ground floor, first to the third floor and an unheated attic. The building material consists of Reichsformat bricks plastered on both sides, with a wall thickness of 58 cm on the ground floor and 38 cm from the ground floor upwards. The intermediate ceilings of the storeys are mainly wooden beams; only the end to the unheated basement rooms is made of reinforced concrete. The current roof is an uninsulated rafter roof covered with plain tiles. Since it was built, there have been no significant changes to the building structure; only the windows were replaced with double-pane insulating glazing in 2011.

The building obtains thermal energy via a district heating connection from N-ergie (Nuremberg municipal utilities). The total electrical consumption is also covered by mains supply, as there is currently no electrical generation in the building. Heating energy is supplied to the individual residential units via radiators, while domestic hot water is provided using electric instantaneous water heaters in the individual flats. The rooms are ventilated via individual window ventilation.

b. Challenge

To achieve a reduction in the energy demand of the entire building, constructive measures are to be resorted to, among other things. In the case of the extension, parts of this are the avoidance of thermal bridges, a low heat transfer coefficient of all building components and an airtight construction method. On the other hand, technical measures are heat recovery for wastewater and ventilation, intelligent, interactive and energy-optimised building automation, and the reduction of line losses. The addition of new storeys will be carried out accordingly. In the renovation of the existing building, a new thermal envelope is attached to the outside of the existing façade. This façade not only serves to reduce the heat flow from the building and thermally activates the existing masonry. The fire protection requirements of building class five are to be combined with ecological and sustainable building materials for both the addition and the renovation.

In addition to saving energy through the renovation of the existing building and the energy-optimised new storeys, a maximum of renewable energy is generated on the building. This is achieved through photovoltaic and solar thermal systems on the roof and façade. A zero-energy house standard is achieved by increasing the energy yield in the existing building below.

c. Reduction of the energy demand

In the case of energy renovation, the focus is on making the energy supply sustainable and efficient. However, to do this ecologically, the first step in retrofitting the building should be reducing energy demand. A sustainable and economic consensus must be found between the resources and energy required for energy production and energy demand reduction.

The most significant intervention in the renovation of the existing building is the installation of a new façade on top of the existing exterior wall. This can be divided into two levels, an insulation level and a heating level. The heating level, which thermally activates the existing wall made from Reichsformat bricks, and the insulation level minimises heat loss. New windows have also been installed in this new façade to keep the interference with the existing flats as low as possible.

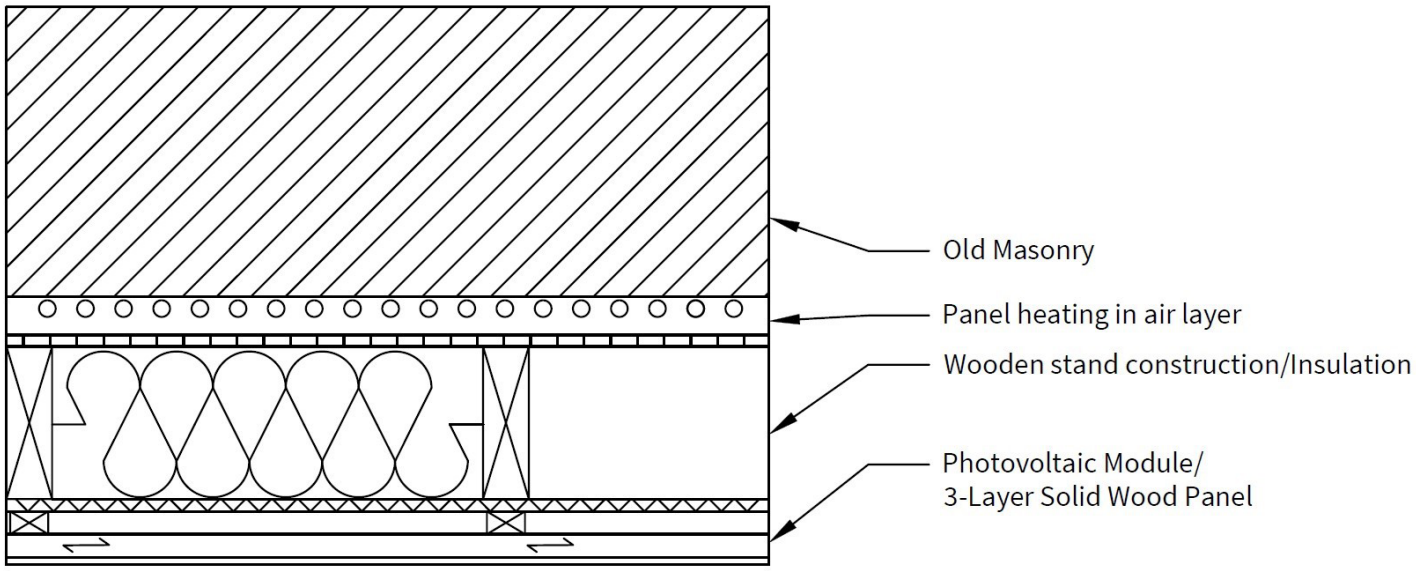
By installing the new façade, the heat transfer coefficient of the exterior wall can be reduced from 1.48 W/m^2K to 0.18 W/m^2K. But thermal energy is not only saved in this way. By activating the high thermal storage mass of the existing wall, the exterior walls of the flats are base-conditioned, which means that the previous flow temperatures of the existing radiators can be lowered. The consequences of this are a lower network loss in the hot water distribution of the existing building and the possibility of using lower temperature levels for heating the building.

Another measure to reduce energy demand is heat recovery. Therefore, ceiling-mounted ventilation units with heat recovery are installed in the bathrooms of the existing flats. The supply air is introduced into the corridor of the individual apartments and then distributed into the separate living rooms via active overflows above the doors. On the one hand, this duct-free air distribution requires only a small intervention in the existing flats, and on the other hand, it requires less material.

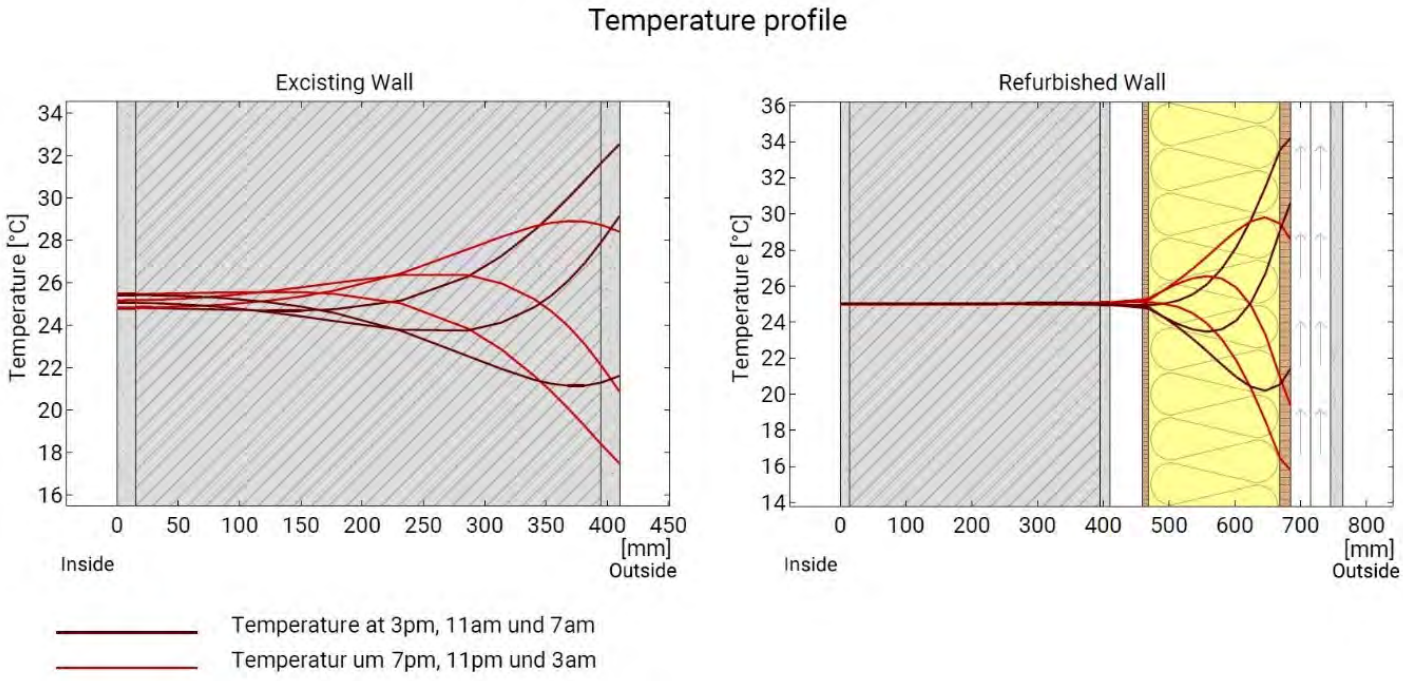
Energy requirements can also be reduced in the preparation of domestic hot water. By installing shower channels with heat recovery in combination with an electric instantaneous water heater, the energy demand for hot water can be reduced by up to 40 %. The basic principle is an integrated wastewater heat exchanger that preheats the drinking water.
Since both measures, the ventilation system and the shower channel, extend to only one room, the energy demand can be reduced

with little intervention in the existing living space.

In the storey addition, the energy requirement is to be kept low. Therefore, the building envelope is designed to have the lowest possible heat transfer coefficients. An excellent U-value is also achieved for the glass surfaces with the help of vacuum glass.
The same heat recovery methods are used in the extension as in the renovation of the existing building. On the one hand, shower channels with heat recovery are used, and on the other hand, wall-mounted ventilation units are installed instead of ceiling-mounted ventilation units



Wall structure of the renovated existing exterior wall



The temperature profile of existing wall vs refurbished wall

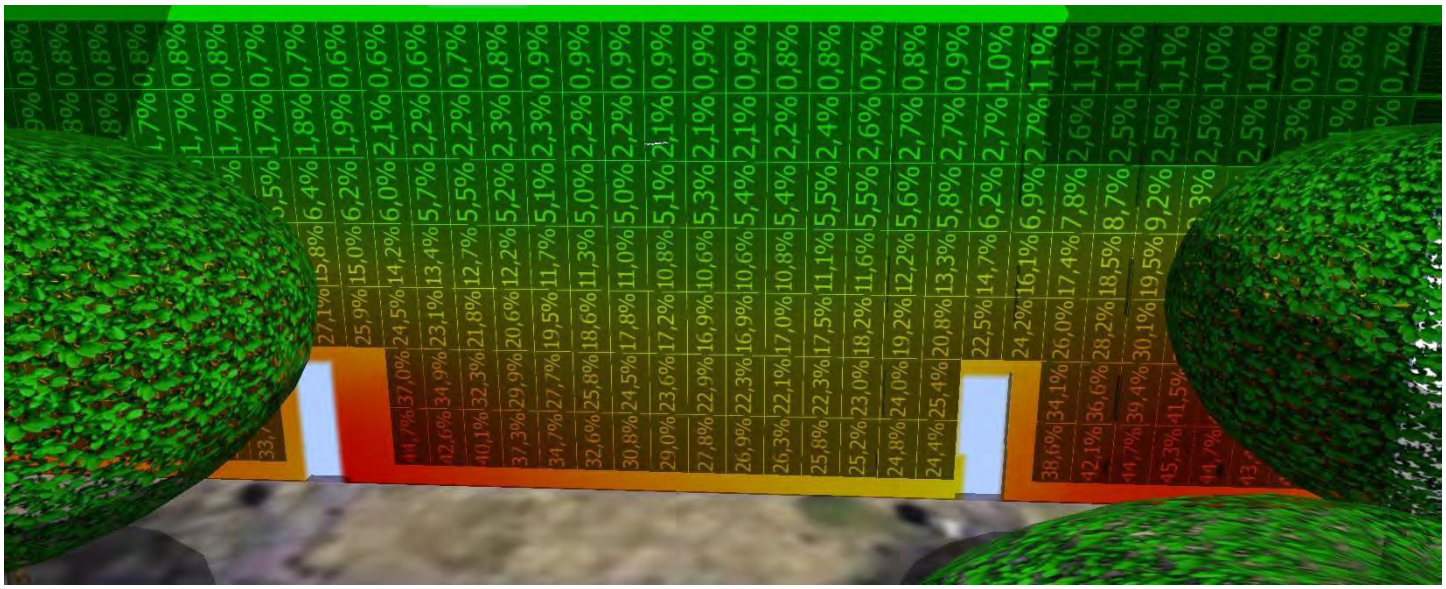
d. Photovoltaics

A photovoltaic system is integrated into most of the building envelope to cover the electricity consumption. For this reason, the roof surfaces are to be equipped with high-performance PV and PVT modules, and the façade of both the extension and the existing building is to be designed as a photovoltaic façade. The simulations necessary for the designs are carried out with the simulation programmes PV*SOL and Polysun.

A shading simulation is carried out to obtain an overview of the areas used for photovoltaics. The south-east and south-west façades and the roof of the additional storeys are simulated. Due to low solar gain, the north-east and north-west façades are not included in the simulation.

Assuming that façade areas with a percentage shading value of over 20 per cent cannot be sensibly used for photovoltaics, the lower two to two and a half metres of the façade are omitted for photovoltaic use, depending on the building section. The façade and the roof of the additional storeys are mainly free of shading. The areas of the façade that cannot be used due to excessive shading are to be cultivated utilising façade greening. It should be noted that the percentage shading value refers to the annual irradiation and not to the yearly yields.

Following market analysis and comparative simulations of photovoltaic modules, PVT collectors from Dualsun and high-performance modules from LG were chosen for the roof. A small part of the roof surface will be covered with semi-transparent modules from Sunovation to allow daylight to enter the common areas below. Thermal energy will not only be generated on the roof, but façade modules in different colours will also be installed on the southwest and southeast façades. These modules also come from the Sunovation company and are individually manufactured according to the customer's wishes. This results in a total electrical output of 574 kW. A detailed analysis of the PV surfaces can be found later.



Example of shading simulation of a south-west façade section with PV*SOL

e. Heat generation, distribution and reduction of building energy demand

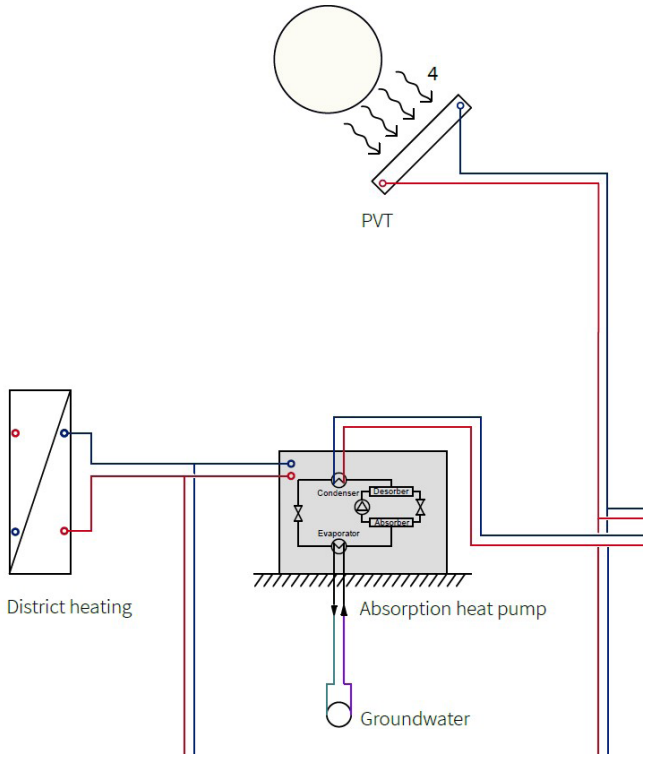
Since the concept of the building should be transferable to a wide variety of locations, a LowEx concept with a maximum heating flow temperature of approx. 25°C was developed for the heat supply of the building, which has a high degree of self-sufficiency and whose residual heat demand can be covered by any form of district heating network or heat pump. By activating the existing exterior walls, which have very high masses in this type of building, the heat supply can be adjusted to the needs of the respective supply network in a time-shiftable manner.

Due to the low flow temperature, the external supply can be provided via low-temperature district heating with an additional heat pump for hot water. In high-temperature district heating networks, the building can also be integrated into the return pipe to improve the heating network's efficiency and enable a later conversion of the heating network to low temperature. However, suppose such a conversion is only planned in the medium term, and sufficient groundwater or a sufficiently large wastewater pipe is available. In that case, it is recommended to use an absorption heat pump (AHP), as this reduces the district heating demand by about 40%. Due to the very low heating temperatures required, return temperatures into the heating network. 50°C can also be achieved with a well-dimensioned absorption heat pump.

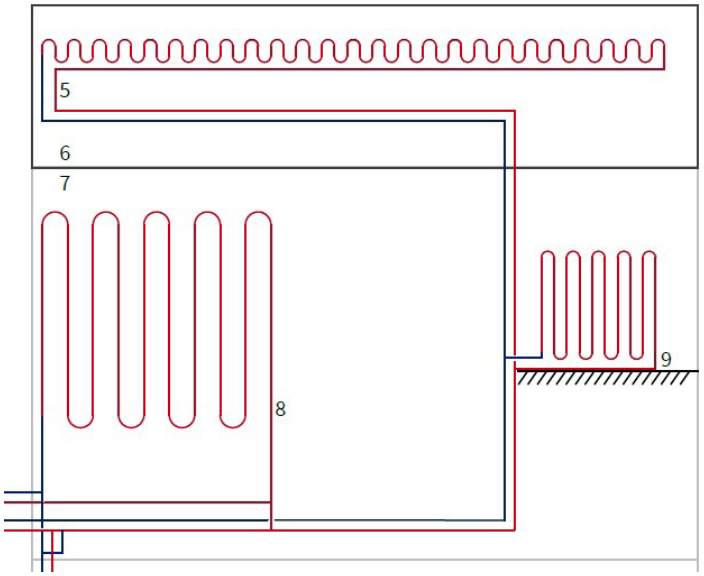
Depending on local conditions, an air, ground or groundwater heat pump is installed without a district heating network. Even the use of gas AHPs is possible later, should this prove useful in the future. Since the district heating of N-ERGIE Nuremberg has a CO2 emission factor of zero and a primary energy factor of 0.27 certified according to FW309-1:2020, this is currently the most sensible external heat supply for the site. Both suitable groundwater and a suitable wastewater pipeline are available at the site, so an AWP has been planned. The use of wastewater was investigated, but does not yield better temperatures than groundwater use. The most minor commercially available system produces a significantly higher output than required, so implementation only makes economic sense as part of a neighbourhood concept.

To keep the heat consumption from the grid low, parts of the roof PV system are designed as PVT collectors. These fulfil several tasks: Drinking water preheating, heating supply at sufficient temperatures and, in summer, night-time cooling of the existing façade via radiation cooling.

The heat distribution systems are explained first to show the interconnection of the respective heat sources. Underfloor heating is to be integrated into the extension's heat distribution system. The advantage of underfloor heating is that it can supply heat to the room and be used for cooling in summer.



Schematic representation of PVT, district heating and absorption heat pump



Principle diagram of the heating distribution system: 05 - Undergroundfloor heating/cooling; 06 - Addition of storeys; 07 - Existing building; 08 - Facade heating; 09 - Existing radiators

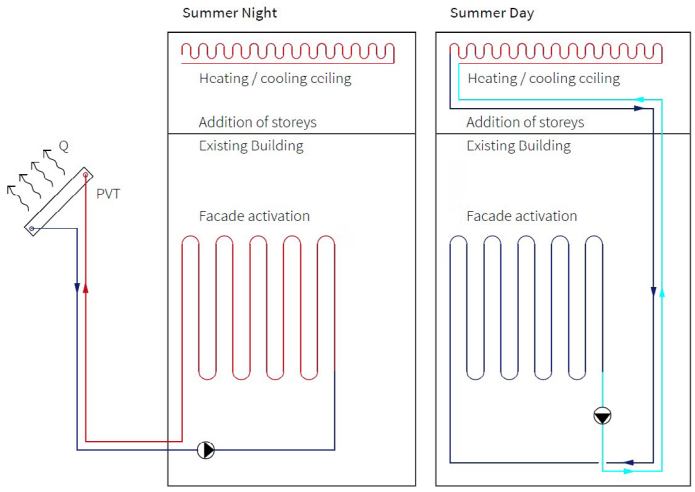
High-temperature radiators are currently installed in the existing building below. To keep the conversion measures as low as possible, a façade heating system integrated into the prefabricated facing façades will be installed. This façade heating will be installed between the existing façade and the new thermal envelope. It will thus thermally activate the old exterior wall and take over the primary temperature control of the existing building. The individual room temperature can then continue to be controlled with the existing radiators. Due to the primary temperature control of the exterior walls in combination with the improved envelope, the power requirement of the radiators is reduced to such an extent that they also only require low flow temperatures. In addition, a very high thermal storage mass is obtained.

The additional thermal storage mass gained through façade activation has another advantage. The diagram below shows that the façade can be cooled down at night via the PVT. The cooled façade can be used passively to cool the additional storeys on hot summer days. For this purpose, a circuit is created between the façade heating circuits and the underfloor heating circuits, whereby the heat from the extension is transported into the façade.

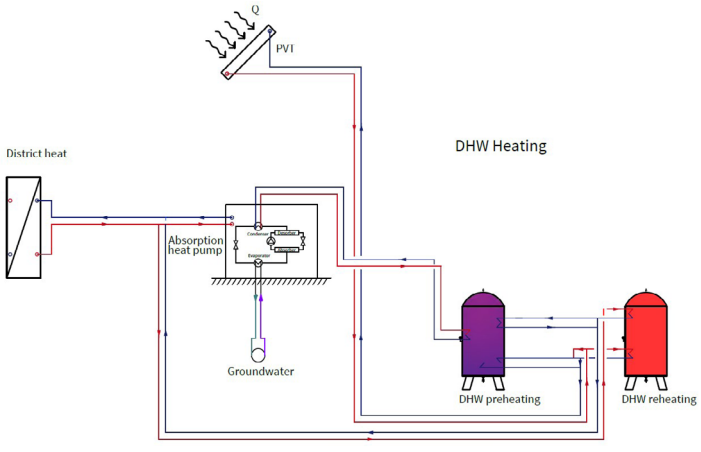
The drinking water in the existing building is heated via decentralised electric instantaneous water heaters. By combining this with a shower channel with heat recovery, energy can be saved. The remaining energy demand is covered as far as possible with self-produced electricity.

The drinking water heating for the renovated building stock will be carried out in 2 steps.

The hot water supply for the additional storey, on the other hand, will be supplied via decentralised fresh water stations. The riser pipe to the stations will first be preheated by a heat source with a low-temperature level and then brought to a higher temperature level by another heat source. While the absorption heat pump can only be used for preheating due to the low-temperature level, the PVT collectors can be used for preheating and post-heating depending on the irradiation intensity. If the temperature of the PVT collectors is too low, the reheating can be done via district heating. Since the bathrooms and kitchens of the individual residential units are always placed nearby, legionella protection is thus ensured by a filling quantity of the pipes of less than 3 litres, and no thermal protection is required. Separate heating water risers with high-temperature levels are provided for this purpose.



The cooling concept for the extension: loading and unloading the façade



DHW Heating

Ventilation technology with heat recovery plays a decisive role in the project. Losses can be significantly reduced through controlled ventilation with heat recovery. The ventilation concept for both the additional storeys and the existing building is based on demand-oriented ventilation control.

Each flat's central supply and exhaust air system is selected as the ventilation concept. A ventilation system with heat recovery is necessary to reduce ventilation heat loss. In addition to adequately dimensioned thermal insulation, this is an essential component for achieving the Plusenergiestandart. In addition to the energy aspects, controlled living space ventilation also offers other advantages such as improved thermal comfort and the possibility of filtering the outside air. Three different designs are available as concepts for supply and extract air systems. Centralised building, centralised flat or decentralised/room-by-room. A centralised building design requires less effort for filter replacement, but fire protection requirements must be observed. This results in additional expenses due to the maintenance of the fire dampers. Also, exact billing to the individual tenants is not readily possible. The decentralised, room-by-room variant is the least complex variant, but it has disadvantages compared to a centralised system. A noise source is located directly in the standard room; each unit has a separate filter (high maintenance effort). The technical service life of ventilation units is estimated at 20 years (VDI 2067). The investment costs of a centralised and decentralised variant for each flat are comparable. However, the costs of the decentralised variant exceed those of the centralised variant after a unit replacement after 20 years (since the complete system must be replaced in the decentralised variant, in the centralised variant, „only" the unit must be replaced, the pipe system can continue to be used) (see AIR-COSIM final report, TH-Rosenheim, 2022). For these reasons, a centralised concept for each flat was chosen as the ventilation concept.

A wall-integrated ventilation unit with a 2nd room connection is selected as the ventilation unit (e.g. BluMartin or fresh-r) (both units are certified by the Passive House Institute www.passivhaus.de). This can be integrated into an exterior wall in a space-saving manner, like a decentralised ventilation unit. However, it offers the advantage that the unit can be located in a room with less stringent sound insulation requirements (e.g. bathroom) and still supply air to several rooms. The supply air is brought into the corridor and transported to the individual rooms with active overflow fans in the partition walls. This eliminates the need for a duct network in the corridor. This reduces the pressure loss that the fan has to overcome and thus the electrical energy consumed. This concept is particularly suitable for refurbishments, where it is often impossible to install additional ducts and the associated suspension of the ceiling.

By measuring the air quality in the central ventilation unit and the active overflow units, the air volume can be adjusted to the demand for the entire utilisation unit and individual rooms. This enables a further significant reduction in the final energy demand while maintaining the same air quality.

The ventilation unit should have an enthalpy heat exchanger since the air in utilisation units with controlled residential ventilation is usually very low in the winter months. An enthalpy heat exchanger can recover some of the moisture. This reduces the problem of dry air and thus the induced health consequences.

As the external walls of the flat serve as fire protection walls, they cannot be used as an installation level without further ado. When penetrating the fire protection section, it must be ensured that the corresponding fire protection class is maintained. The installation level behind the exterior walls was dispensed with to circumvent this. A radio-based solution was chosen for the light switches, where the light switches are glued to the wall, and therefore no installation box is necessary. The sockets and network outlets are mounted on a skirting board in front of the exterior walls but are not excessively intrusive, with a thickness of 2 cm. This offers the additional advantage that the sockets and network sockets can be repositioned later with relatively little effort. Thus, the position can be adapted to different requirements.

Intelligent and user-friendly building automation will be rounded off the energy reduction measures. This includes, among other things, adequate and demand-controlled shading to achieve an optimal supply of daylight all year round and, in addition to passive solar gains, to increase the saving of electricity for artificial lighting. Furthermore, summer heat protection is to be ensured. Monitoring is used to conclude user presence, user behaviour, heating or cooling requirements. The occupant of the flat receives feedback on his current energy consumption and behavioural recommendations, for example, to be able to influence the load status of the building (e.g. a request for the use of the washing machine, etc.).

The individual parameters of the energy supply are to be controlled and recorded via building automation to realise an energy-efficient building via energy and load management.

f. Rainwater collection and infiltration

Climate change is noticeable in rising annual mean temperatures and changing precipitation events. Increasingly frequent heavy rainfall events and decreasing total precipitation pose significant challenges for municipalities and supply/disposal companies. The consequences are falling groundwater levels, the associated scarcity of fresh drinking water, and flooding during heavy downpours due to an overburdened sewer network. Therefore, it is essential to handle drinking water carefully, integrate alternative solutions, and create a comprehensive concept for maximum utilisation of the available water.

To irrigate roof gardens and façade greening in a resource-saving way, the direct use of rainwater is a good option. Above all, the collected rainwater is ideal for watering the plants due to the low degree of hardness. Since the rainwater is used exclusively for irrigation purposes and not for sanitation, additional fine filtering is unnecessary. A so-called „rain collector" intercepts the water in the downpipe from the rain gutter and directs it into tanks. Due to the unique shape of the component, the insert is flooded at maximum fill level, and the excess water flows directly into the infiltration system located in the ground. Six rainwater storage tanks are accommodated in the extension; each garden area or greenhouse has its own tank. This is not only for static reasons, but the arrangement of the tanks close to the consumer also saves on pipe runs and pumping power. In addition, depending on the equipment level of the neighbourhood, there is a choice between automatic or manual irrigation.
The infiltration network consists of a system of underground tunnel trenches. The excess rainwater from the downpipes is channelled into these and stored. The open bottom allows part of the water to seep away slowly. At the same time, water reaches the top through lateral slits and the capillary effect of the soil. This effect permanently irrigates the green areas around the building. A second positive effect is the evaporative cooling caused by the surface water. In addition, the moist soil positively influences the infiltration of further rainwater, which prevents surface runoff on the property.
In many places, decentralised infiltration is not possible, as described above, but the system can also ensure temporary retention of the water (retention). This is protected from overloading and can be dimensioned smaller through a throttled outflow into the subsequent sewer system. This means that the system can be adapted to all locations.

g. Greywater use

The treatment of greywater that is not heavily polluted relieves the municipal water system in two ways. On the one hand, less wastewater is discharged into the sewage system, and on the other hand, the demand for precious drinking water is reduced. Around one-third of daily water consumption in the household is used for personal hygiene. This wastewater from showers and washbasins is only slightly contaminated and can be purified directly in the house to drinking water quality without requiring much energy. Before biological degradation occurs in a packed bed, the wastewater is pre-filtered. Ultrafiltration occurs in the bioreactor using special fibres supplied with oxygen by a blower.

The service water stored in a freshwater tank is then used for flushing the toilet and the washing machine, for which it is ideally suited due to its low degree of hardness. This also saves on detergent. Thanks to the high treatment quality, the purified water can be used to replenish the rainwater tanks. In case of excess, it can be discharged into the infiltration system without hesitation (see manufacturer's confirmation in the project specification). Six treatment systems are installed in the extension for space and load distribution. These are placed in the areas between the flats. Each system supplies 5 or 6 apartments and one rainwater tank each.

2. Transfer to HDU

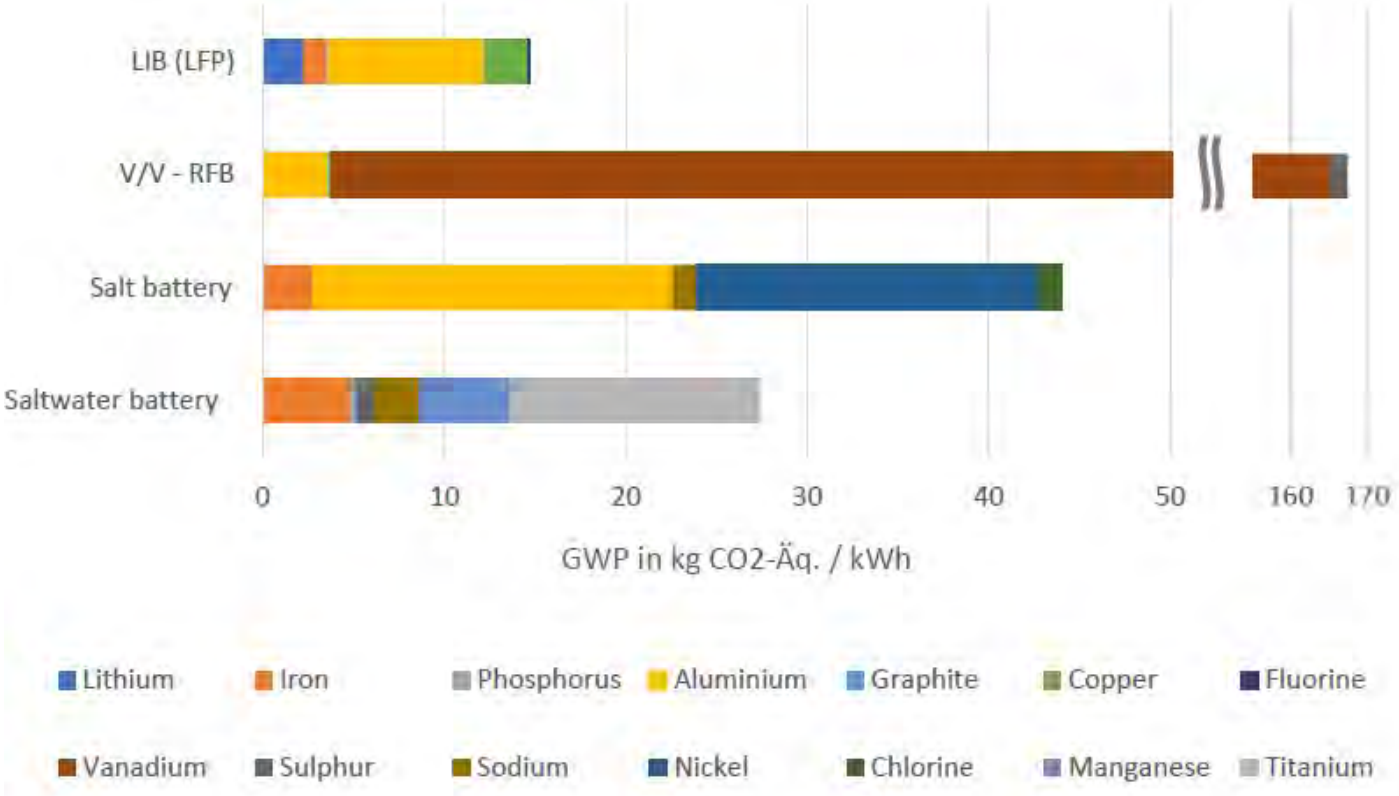
a. Energy concept

As with the entire additional storeys, both the roof surfaces and the façade of the HDU are to be used for solar energy generation. Due to the performance restrictions imposed by the regulations, the entire south façade will be fitted with a façade photovoltaic system. Still, electricity will only be generated via PVT collectors on the roof. Ten uninsulated Spring 375 Shingle Black modules from Dualsun were chosen. Each of the modules has a nominal output of 375 watts.

A Symo Gen24 3.0 Plus from Fronius was chosen as the inverter. The search for a suitable battery storage system proved to be very complex. Despite a lively exchange with various manufacturers, no battery storage system compatible with the inverter and with a capacity that complied with the regulations was found. The option of only using individual stacks of battery storage was also investigated. However, it had to be discarded, reducing the voltage, and the storage is no longer compatible with the inverter. The funda-

mental problem is that efficient inverters operate in the high-voltage range, and therefore, the energy storage units also operate in this range. Consequently, it was decided to use a storage unit with a larger capacity and to limit it electronically.

For the selection, a market study including the analysis of the global warming potential of different energy storage devices was conducted. Based on the results, a cobalt-free lithium iron phosphate battery (LFP), the B-Box Premium HVS 5.1 from BYD, was chosen.



GWP for the production of raw materials for the different storage cells

The energy storage unit has a standard capacity of 5.12 kWh. According to the regulations, however, only 2.5 kWh are allowed. To circumvent this problem, the battery storage is electronically limited via Modbus. In addition to the capacity, the charging and discharging power are also adapted to a 2.5 kWh storage unit via Modbus. A corresponding confirmation from Fronius and BYD can be found in the project specifications.

To not violate the rule of the maximum installed electrical power of 3 kW, only eight modules are connected electrically for the competition. On the other hand, all ten modules are connected hydraulically. The background to this is, on the one hand, the before mentioned night cooling via the collector surfaces and, on the other hand, the domestic hot water preheating.

Since the groundwater absorption heat pump and the district heating connection are not feasible for the HDU, the heating concept must be adapted accordingly. The idea of the HDU would correspond to the planning of the entire building if it were realised with an electric heat pump. An electric heat pump replaces the AHP and district heating, and a cold storage tank replaces the thermal mass of the façade heating of the existing building. In summer, the PVT collector is sufficient as a heat source; a geothermal heat basket will be added for later use of the HDU in Rosenheim. The cold store

will also be used as a heat store for heating in winter, similar to the façade heating. A heat pump from Ecoforest is planned. The eco-GEO 1-6 Pro has a heating capacity of 1.0 to 6.0 kW and a COP B0/W35 of 4.3. The compressor can also be modulated between 15% and 100%. At the lowest level, the electrical power consumption is approx. 500 watts.

This heat pump was chosen because it is the first series heat pump with the natural but flammable refrigerant R290 (propane), which can be installed indoors without restrictions due to its charge of only 150 g of refrigerant. Propane has a GWP of only three compared to 2080 of R410a, the refrigerant most commonly used for heat pumps. We consider this point essential because although the refrigeration circuits of heat pumps are hermetically sealed, one must assume a total annual leakage rate across all heat pumps due to maintenance and damage. The UBA puts this at approx. 2.5% [Reporting under the United Nations Framework Convention on Climate Change and the Kyoto Protocol 2017 - National Inventory Report] and assumes that, in the event of extensive electrification of the heating market, 10 million heat pumps will be installed in Germany in the future with an average filling quantity of 1.5 kg R410a, in which case the continued use of R410a would lead to additional annual greenhouse gas emissions of approx. 0.78 Mt CO2.

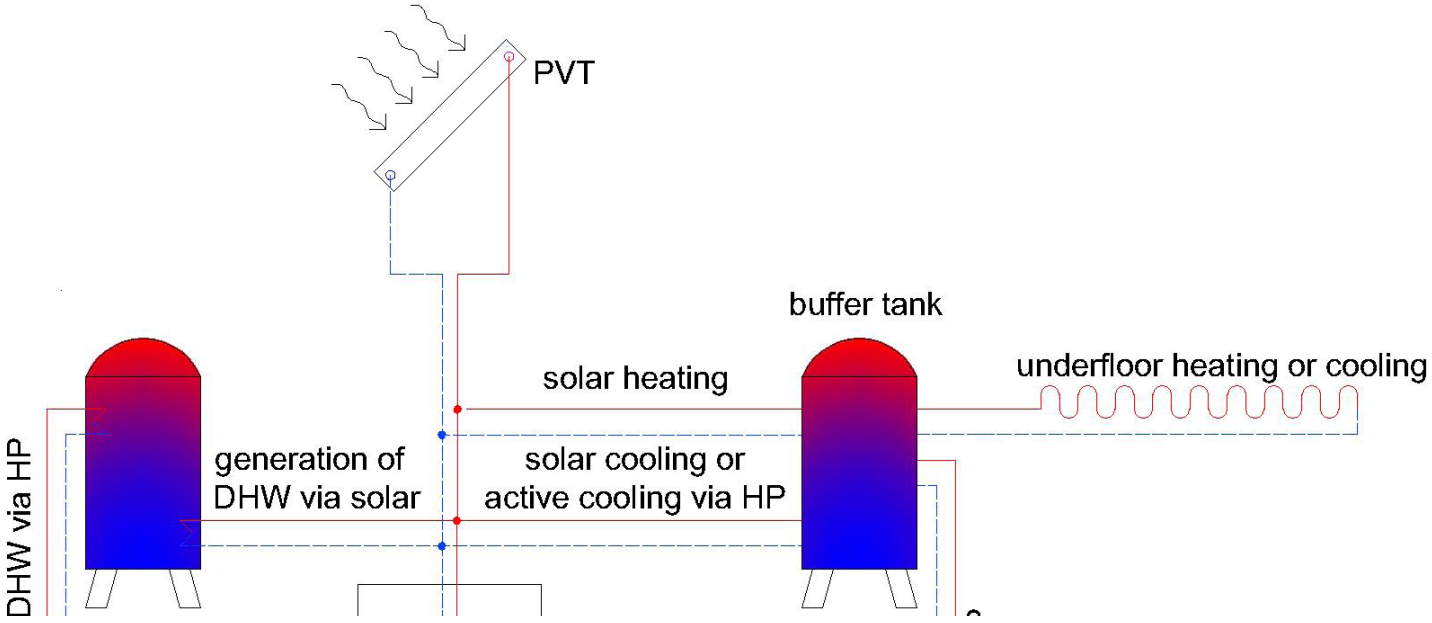
Table 1 Extract the essential refrigerants used today with their global warming potential (GWP)

Category	Refrigerant	GWP
FKW/HFKW	R134a	1430
FKW/HFKW	R410a	2090
FKW/HFKW	R407C	1770
FKW/HFKW	R32	675
Natural refrigerant	R290 (Propane)	3
Natural refrigerant	R717 (NH3)	0
Natural refrigerant	R744 (CO2)	1

The hydraulic concept for integrating PVT collectors and heat pumps is explained below. The waste heat from the PVT collectors is used on the one hand for DHW preheating and, on the other hand, as the primary energy source for the heat pump. A hot water buffer tank is loaded via the heat pump, which ensures the provision of hot water via a freshwater station. In addition, a shower channel from the Joulia company is planned for heat recovery for preheating cold water. A second buffer storage tank, on the other hand, fulfils the function of a cold storage tank. This is to be cooled at night via the PVT collectors by radiation and convection to cool the HDU on the one hand and the PVT system on the other to increase the PV cells' electrical efficiency.

In addition, the PVT system can be cooled via the primary return of the heat pump. Since both the temperature and the electrical power of the collectors are directly related to the irradiation, high collector temperatures also prevail when the electricity yield is high. To increase self-consumption, the heat pump should charge the hot water tank when irradiation is high, which automatically cools the collectors and, at the same time, gives the heat pump a better COP due to the higher primary-side flow temperature.

For the after-use of the HDU, the connection of the heat pump to the underfloor heating has already been planned.



Schematic diagram heating

b. Ventilation concept

A central ventilation unit from Maico, type WS3000, was used in the HDU. This has higher maximum volume flows. These are required to meet the maximum CO2 concentration of 650 ppm required in an earlier version of the regulations for a maximum number of 8 people.

c. Building automation

In building automation, attention was paid to an integral approach. Therefore, one system can control and read out all building services systems (heat pumps, PV, ventilation, and household appliances such as WM/dryer). This offers the advantage of being able to coordinate all energy flows optimally. Combined with a radiation forecast, the consumption can then be adjusted to the energy production using load management. For example, the WM can automatically start its washing cycle when sufficient electricity is available from the PV system. This offers the possibility to react to internal and external demands regarding consumption and production. The calculated, smart readiness indicator (SRI) according to EPBD 2018/844 is at least 77% for our building. In addition to the processes automated by the GA, the user should get a feeling for the consumption and availability of energy through visualisation and feedback on actions.

Building automation can help save energy. However, most sensors and actuators also require power to operate. This can lead to the potential savings from self-consumption being cancelled out. When selecting the components to prevent this, special attention was paid to energy efficiency. For this purpose, EnOcean Energy Harvesting Technology sensors were chosen for light switches, room climate sensors, and window contact sensors. This means that these sensors draw the energy required for operation from the environment and thus do not contribute to the energy demand of the occupancy unit. KNX actuators were used for the actuators to switch the circuits and the lights. These have a power consumption of < 0.4 W per actuator. The use of radio technology offers the additional advantage of reacting flexibly to future changes in use.

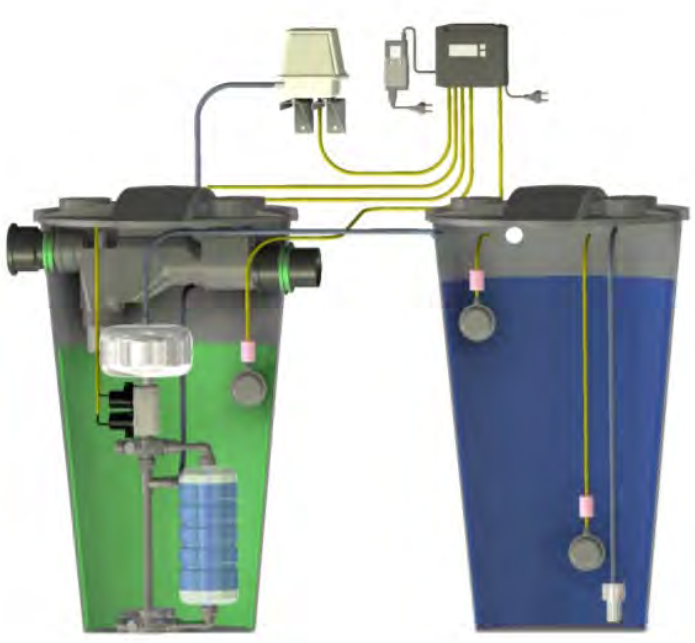
d. Legionella protection

Since the required 60°C can only be achieved with our heat pump using a very high amount of energy, the water hygiene and the associated legionella protection are achieved by constructive measures. Using a freshwater station as a water heater in the direct vicinity of the tapping point makes it possible to connect the consumer points with very short pipe lengths. Thus, we achieve the criterion of small systems with a filling quantity of fewer than 3 litres in the most extended section. Furthermore, high flow rates are achieved through small pipe dimensions, which positively affects deposits in the pipe and the associated germ formation.

e. Greywater and rainwater utilisation

The stored rainwater is used exclusively for watering the botanical gardens, while the toilet flushing and the washing machine are operated solely with greywater. When positioning the tanks, care was taken to realise short connection lines for the consumers. Therefore, the rainwater tanks are placed in the technical room on the upper floor. To avoid additional material costs in the supporting structure and to circumvent the maximum load of 400 kg/m^2, it was decided to install several flat tanks in a row. If there is no rainfall for several weeks, replenishment of the greywater treatment plant is provided. Greywater may be used for irrigation as long as the water is not septic. The treated greywater has a low germ load and can be discharged into the rainwater tank without any problems.

Für die Grauwasseraufbereitung wird die Anlage AQUALOOP der der Fa. Intewa verwendet.



Section of the greywater treatment plant

Technical Data:

Storage volume: 350l per storage tank
Storage tank dimensions: Ø740mm x 1275mm
Weight per tank (empty): 11.5 kg
Treatment volume 200 l/day
Inlet height: 1045mm
Connection diameter: DN 100
Emergency overflow height: 980mm
Integrated pre-filter with rewind nozzle
Bioreactor with integrated membrane station
Blower for flushing the membrane

The system consists of two storage tanks and has a possible treatment volume of 200l per day. We deliberately decided to use only the water from the shower and the washbasin, as treating greywater type B2 (with washing machine water) is not profitable on this scale. For our requirement of grey water (type C2), further filtration would be necessary due to the additional load from the washing machine (germ load and fluff, detergents and surfactants).

Currently, the method of irrigation is still under discussion. The possibilities include an automated irrigation system with a controlled pump or manual irrigation with taps on the upper floor and in the basement.

3. Comprehensive Energy Analysis

a. DC

Both thermal and electrical simulations were carried out for the Wuppertal and Nuremberg sites to verify the energy concept. For the Wuppertal site, the Energyplus dataset for Düsseldorf was used as the basis. For the Nuremberg site (49.4407 °N; 11.1105 °E), on the other hand, a data set was generated with the help of Meteonorm 8. The IPCC RCP scenario 4.5 in 2020 was used to consider climate change.

i. Electrical

To check the influence of shading on the building, the surroundings were simulated in PV*Sol at the beginning of the project, and a shading analysis was carried out for Nuremberg. The result was that the building was largely unshaded. The roof surfaces are selected at 12 degrees to reach a consensus between the optimum inclination angle and minimum inherent shading. Only on the southwest façade are the lower 2 metres of the façade shaded by surrounding trees. Therefore, this area will not be fitted with façade modules. Instead, coloured glass is used in this area to round off the view. In the same simulation, a first load profile and a yield simulation were carried out to obtain a basis and reference values for the further planning the architecture and energy concept.

Both the load profile and the planning have now been continuously adapted. Due to the decision to use PVT for parts of the roof installation, the simulation programme was also changed to include the thermal component. The decision was made to use Polysun to create a holistic simulation of the energy concept. The electrical consumption consisted of the domestic hot water preparation of the existing building, the ventilation, the pumps, the electromobility and the occupant-dependent consumption. For this purpose, current load profiles for the theoretical final energy consumption were created and read in.

Only the flats in the existing building are included in the electrical load profile for the usage energy demand for domestic hot water preparation. The additional storey is supplied via freshwater stations and thus counts as a thermal load. Due to the short distribution paths, a hot water temperature of 43 °C can be assumed here, as legionella protection is guaranteed. The hot water demand is 50 litres per day and occupant, distributed using a distribution profile for multi-family houses in Polysun. The load of the decentralised residential ventilation is based on an assumption of 400 W/h per day and flat. It was assumed that the load profile has less consumption during the night hours than during the day hours. For the consumption of electric mobility, a sharing pool with 31 vehicles from different manufacturers was used and distributed over different charging times. Finally, a consumption profile was created for the user. This was created once for a residential unit (HDU), considering the components used and the resulting consumption, and then extrapolated to the DC. The pump flow is simulated in Polysun itself.

On the other hand, the areas and products listed in Table 2 were used for the electrical yields. The total power of the PV(-T) surfaces 574 kW. In addition, a 135 kWh battery storage system is planned, which means that with a capacity of a quarter of the PV power, an economical solution with a high degree of utilisation of the energy storage system was found.

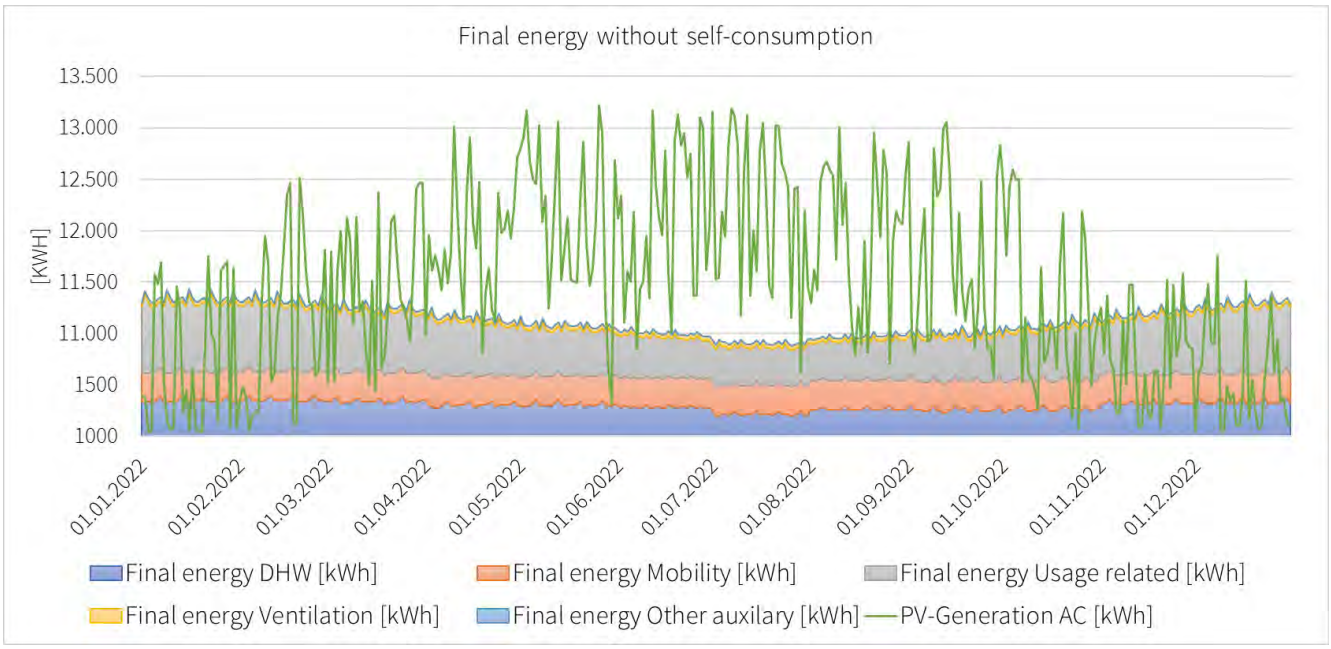
Position	Product	Number/Area	Alignment	Inclination
Roof	DualSun SPRING 375 Shingle Black	400/660 m^2	125	12
Roof	LG 400N2W-A5 (Neon 2 72cell)	352/729 m^2	125	12
Roof	Sunovation eFrom clear	51 m^2	125	12
Facade	Sunovation eForm unichrome	172 m^2	125	90
Facade	Sunovation eForm unichrome	1574 m^2	215	90

Table 2: Areas PV(-T)

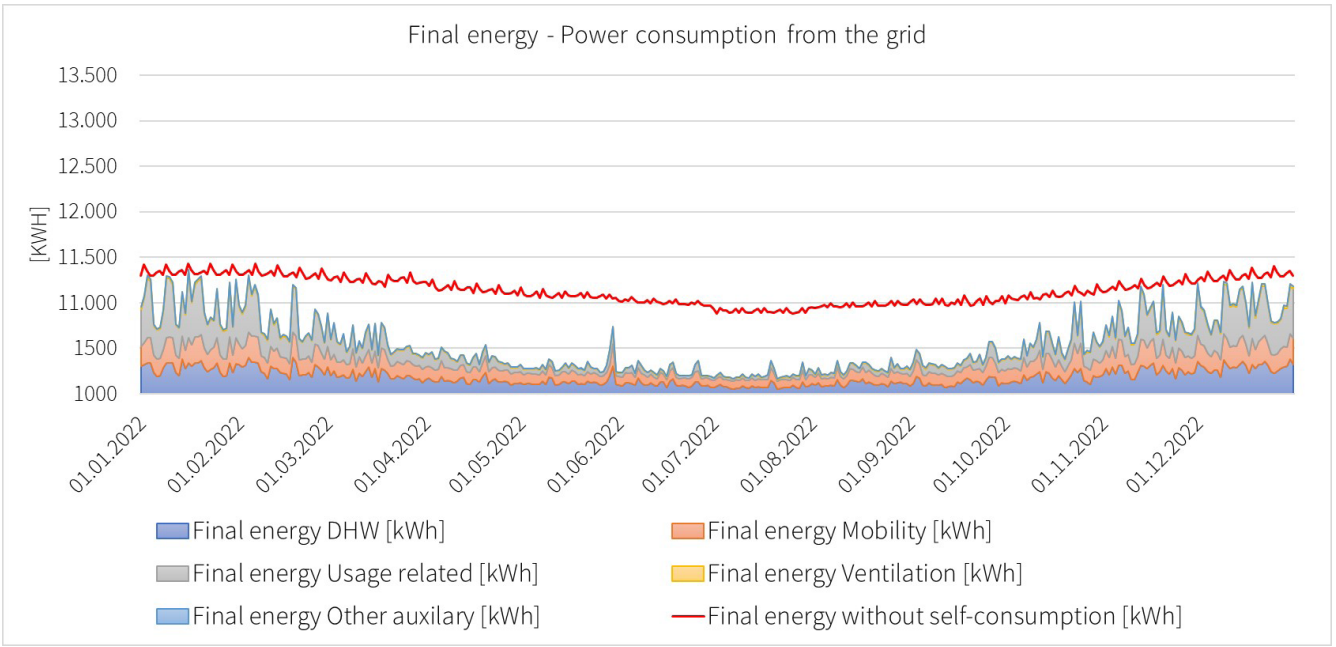
The simulation results for the Nuremberg site are discussed in the following paragraphs. The results for Wuppertal can be found in the project fact sheet. The evaluation was done in hourly steps, but the results are primarily presented in daily steps for clarity.

The PV areas‘ annual yield and the individual consumers‘ final energies are shown below. It should be noted that this does not yet include direct consumption from the loads.

This results in a total annual load of 413.1 MWh, offset by a yearly yield of 541.4 MWh. This results in a plus-energy building and a negative CO2 balance from the electrical side. The generator output is then compared with the individual loads every hour to calculate the self-consumption of the generated energy. On this basis, the necessary grid consumption of the building can be calculated, resulting in the graph below. This shows that the PV(T) system, combined with an energy storage system, can significantly reduce the amount of energy drawn from the grid.

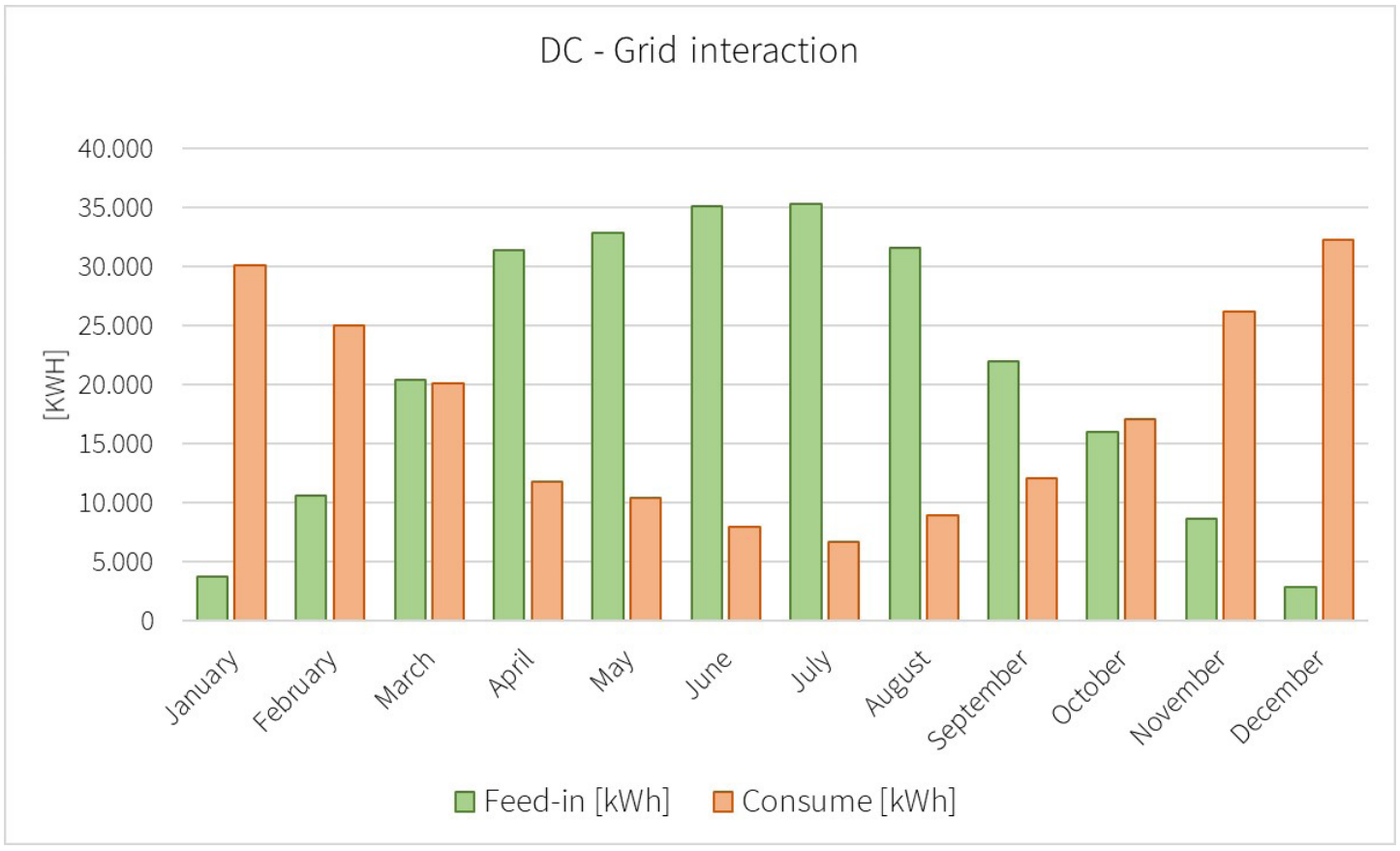


DC Nuremberg - Final energy without self-consumption



DC Nuremberg - Final energy – Power consumption from the grid

However, electricity is drawn from the grid, and the surplus of energy generated by PV is fed into the grid. Due to the increased demand in winter and reduced electrical energy generation, feed-in and draw fluctuates acyclically over the year. As a result, 196.9 MWh are drawn from the grid, and 315.7 MWh are fed into the grid in one year. The system‘s degree of self-sufficiency is 52.1%, and the self-consumption ratio is 41.7%.

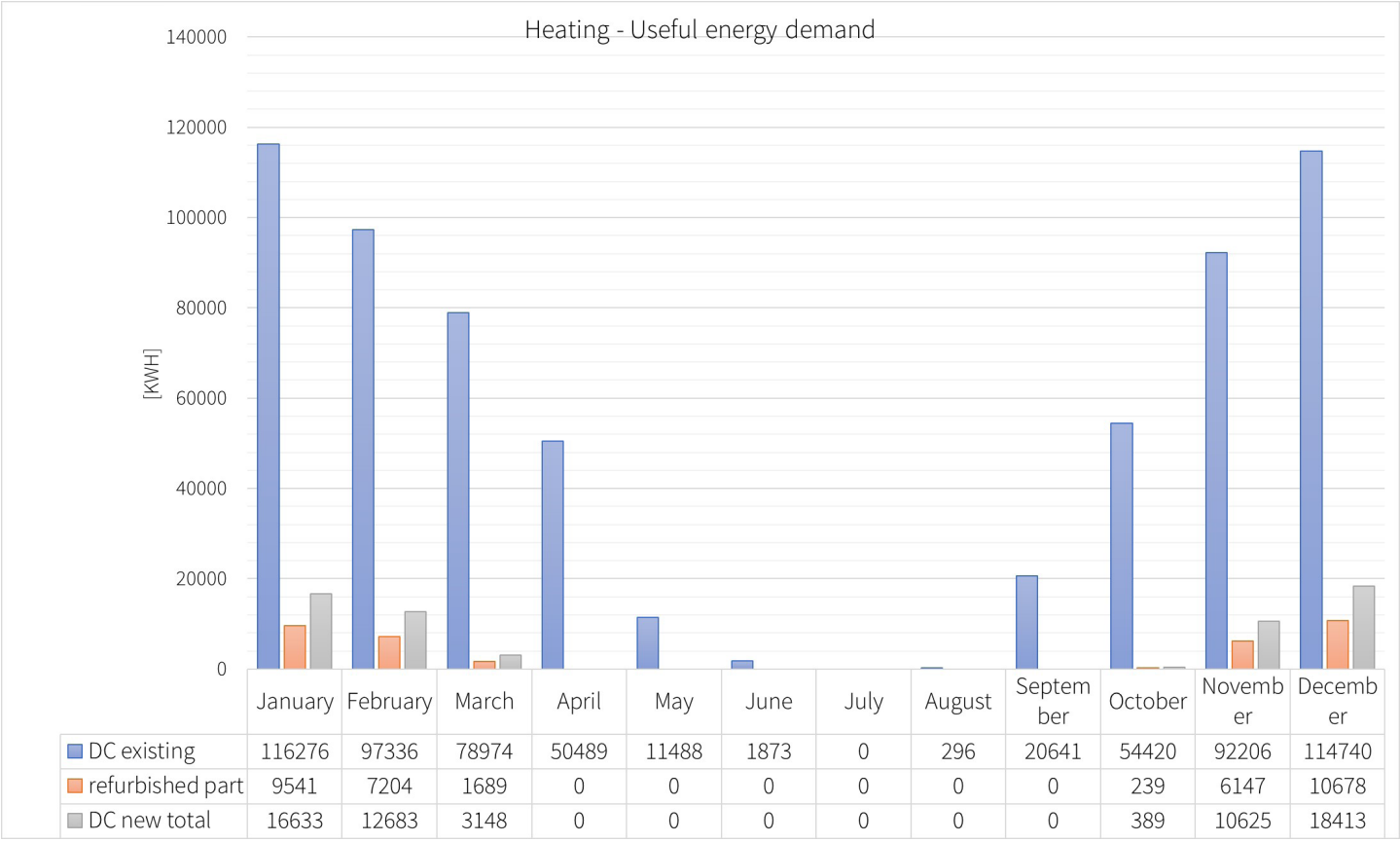


DC Nuremberg – Grid interaction

ii. Thermal

The thermal analysis of the supply is also carried out hourly via Polysun. The useful annual energy required for heating and cooling served as the input parameters. The useful energy for heating was calculated by means of the Hottgenroth energy consultant, via a graphical input of the building envelope and the simulation of the system technology, according to DIN 18599. The required cooling energy was not obtained from the energy consultant due to the low plausibility, instead, individual characteristic flats were simulated in IDA ICE. The cooling power for the entire building was then scaled up.

To demonstrate the energy advantages of the renovation and the addition of a storey compared to the existing building, the energy consultant also calculated the existing building without renovation and renovation without the addition of storeys. The comparison of the required heating demand is shown in the following figure. The renovation minimises the need for useful energy; even including the addition of the storey, the new energy demand is deficient - the renovated and storeyed building has lower heat losses over a year than the existing building in January.



	January	February	March	April	May	June	July	August	September	October	November	December
DC existing	116276	97336	78974	50489	11488	1873	0	296	20641	54420	92206	114740
refurbished part	9541	7204	1689	0	0	0	0	0	0	239	6147	10678
DC new total	16633	12683	3148	0	0	0	0	0	0	389	10625	18413

Comparison of the useful energy demand

For the entire DC, the energy requirements listed in Table 3 result are implemented in Polysun. According to the degree-hour model, the load profile is created based on the weather data.

Table 3: Heating and cooling energy demand DC

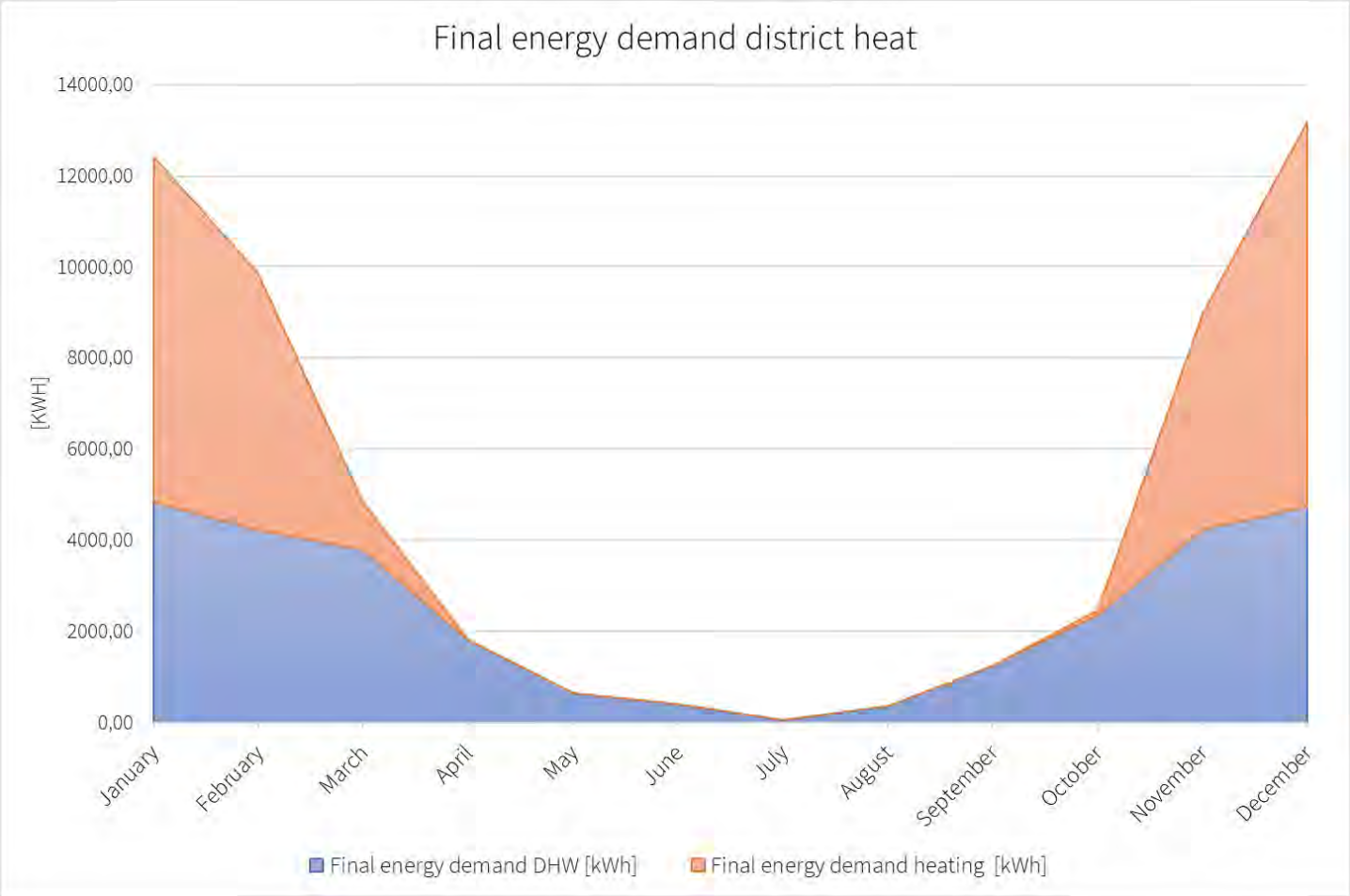
Month	Useful energy demand Heating [kWh]	Useful energy demand Cooling [kWh]
January	16633,00	0
February	12683,00	0
March	3148,00	0
April	0,00	0
May	0,00	241,8525
June	0,00	1648,18
July	0,00	3556,1275
August	0,00	2526,015
September	0,00	53,745
October	389,00	0
November	10625,00	0
December	18413,00	0
Year	**61891,00**	**8025,92**

Another thermal load in the building is the hot water demand of the new storeys, which freshwater stations cover. The load was calculated to be equal to the hot water demand of the existing building. The district heating connection, an AHP, and PVT collectors serve as sources for the heat supply. While the freshwater stations are entirely supplied by the district heating and PVT collectors, an AHP (COP=1.8) is used to heat the building to reduce the district heating demand further. The heat recovery in the shower trough is also included in the thermal model.

After running the simulation, the final thermal energy consumption is obtained, minus the gains from heat recovery, PVT and AHP, broken down by DHW and heating.

This results in a total final thermal energy demand of 56.2 MWh per year, which must be obtained via district heating. The final energy for cooling was not simulated separately, as no active cooling is planned. Furthermore, the useful energy is so low that it can easily be provided by the night radiation of the PVT collectors.

After discussing the thermal and electrical simulation results, it can be stated that the building achieves a plus energy standard through the renovation and addition of more storeys. Although 56.2 MWh of district heating is still consumed, 118.8 MWh of electrical energy is fed into the grid. This results in a plus of 62.6 MWh per year. The CO2 balance is even better since district heating in Nuremberg has a CO2 emission factor of zero. This means that 118.8 MWh of electricity can be considered a negative CO2 factor.



DC – Final energy demand district heat

b. HDU

Table 4 Heating and cooling energy comparison SimRoom and IDA ICE

	SimRoom [kWh]	Ida Ice [kWh]
January	401,18	346,40
February	347,15	297,20
March	272,01	203,50
April	102,75	37,70
May	40,92	21,50
June	-7,97	-1,30
July	-39,07	-6,50
August	-13,14	-4,00
September	0,00	0,00
October	63,00	4,60
November	285,09	194,80
December	395,36	328,00

The HDU was thermally simulated with both SimRoom and IDA ICE. Different results were obtained for the heating and cooling energy demand, as seen in the table below.

Since the input options in SimRoom are relatively limited, it is more beneficial for orientation or to get an overview. IDA ICE is better suited for precise simulation. Among other things, the shading control of the windows was set here. This also results in lower energy requirements, and the IDA ICE model was used for the project facts and the other results.

As with the DC, the hydraulic and electric concept was mapped in Polysun, and different load profiles were implemented. An annual load of 2813 kWh is compared to a yearly PV yield of 2525 kWh. For this simulation, only the yield of 8 PVT modules was used.

Table 2 shows the input data for the simulation, and Table 3 shows the simulation results.

Table 2: Input data for the simulation of the competition system with Polysun

Input data	
location HDU	51,268° North; 7,148° East (Wuppertal)
Weather data	DEU_Dusseldorf.104000_IWEC.epw
Alignment and roof pitch HDU	Azimut: 243°; roof pitch: 12°
PVT-Modul	8 x DualSun SPRING 375 Shingle Black
Inverter	1 x Fronius SYMO GEN24 3.0 Plus
storage	1 x BYD HVS 5.1 (2,5 kWh)

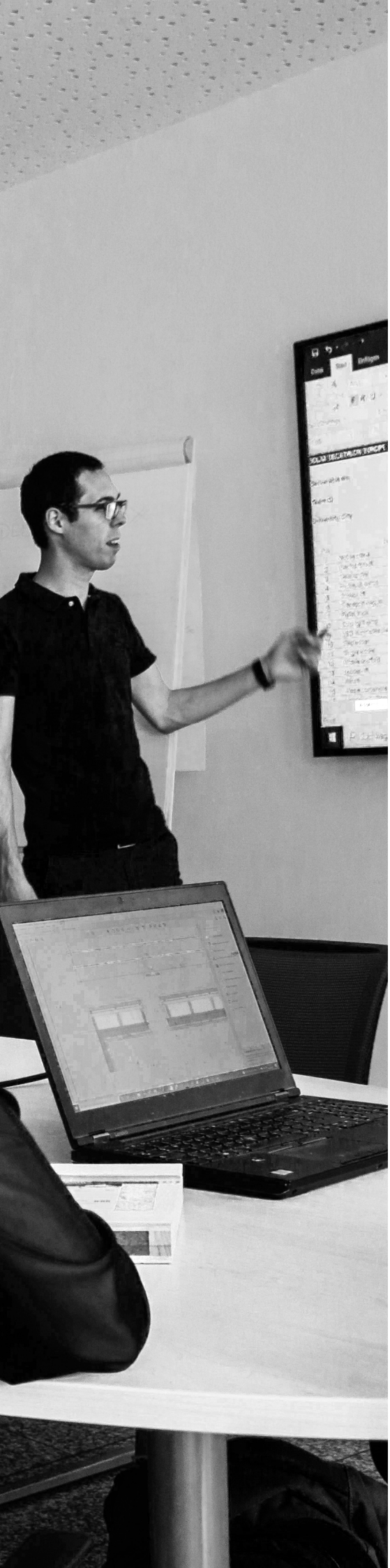
Table 5: Results of the simulation of the competition system with Polysun

Results	
Generation PVT plant	2.525 kWh/a
Consumption HDU	2.813 kWh/a
Grid feed-in	985 kWh/a
Self-consumption	56%
Performance Ratio	80%

Thermally, the energy demand of the hot water can be reduced from 2135 kWh of useful energy to 658 kWh of final energy by the PVT collectors.

c. Life Cycle Carbon Footprint

Unfortunately, it was no longer possible for us to calculate a Life Cycle Carbon Footprint for the HDU‘s building services.



37 Affordability & Viability Report

Table of contents

37.1 Analysis

a) Data of the specific contest

The heterogeneous cityscape of Nuremberg is particularly characterized by its urban areas, which have all developed in varying historical manners. The old town, destroyed during the Second World War, has acquired a historical ambience through its reconstruction. In contrast, the "Weststadt" (west city) has developed into a service and knowledge-oriented business location with the help of company expansion and a new university location. The south is characterized by a multicultural and young population and has a high building density, which explains the presence of numerous large commercial and industrial companies. The industry mix in Nuremberg has led to an increase in the number of employees subject to social insurance contributions. Nuremberg's housing market consists mainly of post-war buildings, which offer predominantly small apartments. The scarce housing supply has also led to significantly greater migration to surrounding communities, despite Nuremberg's attractiveness. However, there has also been an increase in the number of people moving in from abroad. The city of Nuremberg faces the challenge of integrating these new citizens while preventing the flight of higher-income households. Due to its wide range of bicycle paths, the city is very bicycle-friendly. Nuremberg also offers adequate inner-city transport links, and numerous bus lines, trains and suburban trains make it possible to reach major, neighboring cities such as Fürth and Erlangen. The Albrecht Dürer airport is located just north of the city, and is easily accessible by public transportation. The excellent transportation network, in combination with a wide range of leisure activities and facilities, ranging from cultural to sports, makes the Middle Franconian city particularly attractive. The Nuremberg metropolitan region is the second largest urban area in Bavaria after Munich. A central aspect for Nuremberg is its population density, characterized by its broad, strong middle class. Population and age structure have uneven effects on population growth. The effects of demographic change are particularly noticeable here in terms of the aging process of the population. The proportion of elderly is increasing and will continue to rise, while the proportion of children, adolescents, and young adults is decreasing. The influx of a younger group, such as students, could compensate for this aging population. Nuremberg is expected to hav a comparatively young population in 2030, which may even convey a slight increase. However, the strongest population increase is expected among those over 65 years of age. As the population ages, the demand for age-appropriate, barrier-free housing that meets their needs also increases. Relative to this, the need for affordable housing is increasing, especially among the elderly. Rising rental fees effect all social groups, including the elderly, students, and lower income populations. Students, who tend to prefer single, studio apartments or dormitories, are in direct competition with the other two groups mentioned above. Estimating the development of households at risk of poverty is difficult to forecast, but it can be assumed that economic and political conditions will influence this development and will most likely further increase the number of (older) households at risk of poverty. Nuremberg is expanding, and this growth has led to a tremendous demand for real estate and rental housing; however, there is a low potential for residential development. The general aging of buildings is shrinking the current housing stock, and therefore must be supplemented by replacement demand. According to the city of Nuremberg, nearly 600 housing units will need to be built per year in order to maintain the current housing stock. Even though, approximately 8,600 new housing units were completed in 2018, this pent-up demand backlog needs to be addressed. 'Additional demand' is referred to anything over and above population and household growth. The trend continues toward smaller household forms and their associated average household sizes; however, the number of households is increasing faster than the population. An increasing number of individuals are choosing to remain single or childless.

Housing policy plays an extremely important role in this topic. Nuremberg has set guiding goals for this: The city of Nuremberg wants to continue to grow as an attractive metropolis and thus offer more housing. At the same time, affordable, attractive and innovative living space is to be created with target group-oriented improvement and securing of supply in order to strengthen the qualities and the neighborhoods as residential locations. If no action is taken, the preexisting excess demand will steadily increase. Hence, a growing desire and need for affordable, attractive, and sustainable housing in urban areas, without the need to develop more surface areas.

Key figures on Nuremberg as a trade and industry location

GDP (2019)	• City of Nuremberg: 32,3€ billion/ per employee 80,169€ • Nuremberg economic region: 81,9€ billion/ per person in employment 77,304€ • Nuremberg Metropolitan: 147,2€ billion
Retail sales	**3,5€ billion** Nuremberg on 2nd place in DE
Purchasing power of the population	12,8€ billion

Retail sales area in the city as a whole	1,081,400 square meters
Turnover ratio (retail turnover per inhabitant)	3,5€ billion Nuremberg on 2nd place in DE
Turnover ratio of the Nuremberg urban area in relation to the total for Germany	132.5% (DE = 100)
Turnover ratio of the Nuremberg urban area in relation to the total for Germany	8.26%
Purchasing power index (purchasing power per inhabitant)	104.1% (DE = 100)
Purchasing power per inhabitant	24,600€
Export ratio city of Nuremberg (2019)	53.2%
Economic structure	• Agriculture and forestry 0.5% • Production 20.2% • Service 79.3%
Total vacancy rate	2.5%

Key figures on Nuremberg as a trade and industry location

	Very good	good	Moderate to simple
Detached / semi-detached plots	900€ – 1,600€	590€ - 1,050€	470€ - 790€

Purchase prices for existing residential properties (no new buildings)

	Very good	good	Moderate to modest
Detached houses	720,000€ - 1,600,000€	600,000€ - 780,000€	470,000€ - 630,000€
Semi-detached and terraced properties	500,000€ - 630,0000€	430,000€ - 570,000€	360,000€ - 520,000€

Purchase price for owner-occupier apartments

	New	Existing
Owner-occupier apartments	4,700€ - 5,800€ / sq m Ø 5,160 € / sq m	2,550€ - 4,080€ / sq m Ø 3,120 € / sq m

Apartment rents 2020

New rentals, net cold	Modest location	Good location	Very good location
New buildings (first tenant or core redevelopment within last 10 years)	11€ - 13,90€ / sq m Ø 12,40€ / sq m	10,50€ - 14,50€ / sq m Ø 12,12€ / sq m	13,50€ - 17,00€ / sq m Ø 14,80€ / sq m
Existing properties (built btw. 11 - 50 years ago)	8,90€ - 11,70€ / sq m Ø 10,60€ / sq m	9,40€ - 12,10€ / sq m Ø 10,90€ / sq m	9,10€ - 12,25€ / sq m Ø 10,70€ / sq m
Older buildings (built more than 50 years ago)	7€ - 11€ / sq m Ø 9,50€ / sq m	7,50€ - 11,50€ / sq m Ø 9,70€ / sq m	8,90€ - 13,30€ / sq m Ø 10,60€ / sq m

Strengths and Weaknesses of Nuremberg City

STRENGTHS (S)	WEAKNESSES (W)
Has applied to be a cultural capital of Germany	3rd most congested city in Germany after Berlin and Munich
Heterogeneous cityscape - many urban areas with different histories	Dark National Socialist history is part of the city‘s image
Presence of a university and a second technical university is in the planning	Apart from the old city center, not a very attractive building stock
Innovation and business location	High surplus of commuters
Numerous cultural offerings	
Metropolitan region	
Attractive old city	
Deutsche Bahn connects Nuremberg with major labor market centers with its connections	
Attractive location in Middle Franconia - in the immediate vicinity of recreational areas	

b) The District of Ludwigsfeld

In the 1950‘s, a modern, spaciously erected residential development was built on a site covering an area of around 20,000 square meters. No roads, only residential paths through green areas and children’s playgrounds lead to the individual dwellings. The Siedlungswerk Nuremberg still manages and maintains the apartments, which were originally built as part of a social housing development project.

The Development of the District

Ludwigsfeld can look back on an eventful history. During the time of the free and imperial cities of the German Empire, the area of the current housing estate served under the historical name of Peterhaide, and was used as a maneuvering area and a campground for passing troops. In the 19th century, the area was the most important venue for major events before the gates of the city of Nuremberg. Except for a number of interruptions, the Nuremberg Folk Festival took place here from 1826 to 1913. After a visit by Ludwig I of Bavaria, the area was renamed Ludwigsfeld in 1833. In 1914, at the outbreak of the First World War, a large hospital complex constructed out of military barracks was built on the site. The urgent housing shortage after the war caused the barracks to be used as emergency housing and lodging well into the early 1950s. From the outset of the Nazi regime, the northern side of Regensburger Street was developed with elongated rows of multi-family dwellings. By the end of the 1950s, the construction of predominately four-story residential buildings began in an unrestricted manner and was based on the development plans of Nuremberg’s planning office. Most of the new 466 apartments were built by non-profit housing associations such as the Siedlungswerk Nuremberg. With the development of new accommodation, the barracks that had been used as housing began to disappear along with their adjoining community gardens. This change made it possible for the residents of the barracks to move into newly built apartments with “modern” amenities such as gas boilers, sinks, hot and cold running water, and tiled kitchens and bathrooms. Ludwigsfeld developed itself from a shanty-town into a comfortable residential area.

c) SWOT Analysis of the District of Ludwigsfeld

In some places a lot has changed since then, and in others not a lot at all. A SWOT Analysis will help to reveal the strengths and weaknesses of Ludwigsfeld as well as the opportunities and threats that the levelup team are trying to tackle.

Strengths and Weaknesses of Nuremberg City

STRENGTHS (S)	WEAKNESSES (W)
Diversity through a multicultural population	A lack of smaller apartments leads to housing market competition between families and shared apartment arrangements
Good educational facilities attract young people	Unemployment is higher than average
Proximity to large parks, sports facilities and small green spaces promotes exercise and recreation	Recreational activities are geared more towards the older population
Proximity to central city districts is attractive	Large number of older buildings is unattractive Older buildings (up to 1948) are represented by 28.3% and post-1948 buildings by 67.6%
Very good access to public transportation and easy access by car and other means of transportation	Poor parking situation with almost exclusively street parking / High parking concentration
Many stores and restaurants in the north provide jobs and fill the neighborhood with life	Railroad lines run directly past many housing areas causing noise pollution
Luitpoldhain as a center for recreation and nature	Multiple construction sites with ongoing construction schedules
	Problem with an overpopulation of rodents (rat/mouse traps and bait)

OPPORTUNITIES (O)	THREATS (T)
Influx of young people and students	Migration to the surrounding areas due to housing shortages
Multicultural population could bring new businesses to the neighborhood	Segregation or isolation of people from different backgrounds and incomes
The city of Nuremberg promotes housing construction in the lower price segment	Restricted urban development due to numerous historically protected buildings
The rather sporadic housing development in the south allows for easy redensification	Older buildings mean prompt need for refurbishment
Improvement of the parking situation through the construction of (a) parking garage(s)	Enormous increase in real estate prices (nationwide problem)
A large number of buildings with first-floor commercial spaces that can be used flexibly	The external image of a district can be influenced by the origin and income structure of its residents
Ludwigsfeld is located between the city center and Nuremberg‘s largest park, which could attract walk-in customers	
The university provides a demand for offers for young people	
A readiness for new construction and redevelopment among the population	

d) SWOT Analysis of the building

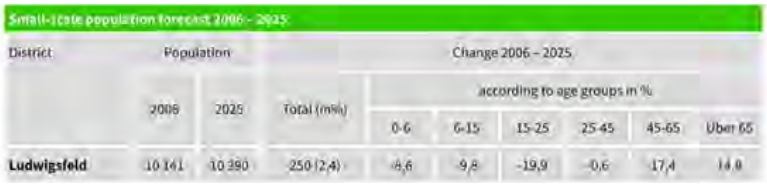
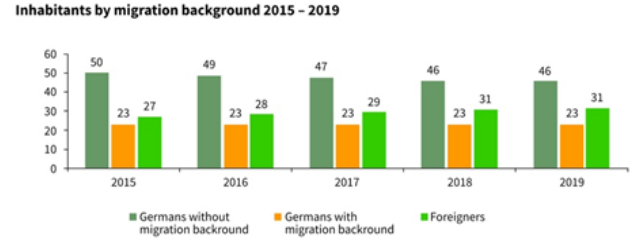
STRENGTHS (S)	WEAKNESSES (W)
Grass verge(s) and a 30 km/h zone between the building and the main road	Poor building fabric
District heating is installed	Angled apartments
Good internet connection	Bad energy certificate
Good views to the south	Not barrier free or handicap accessible
Streetcars stop directly in front of the building	Narrow staircases
Attractive location in Middle Franconia - in the immediate vicinity of recreational areas	Poor, outdated fire protection
Nuremberg main station 3 km away	Unused attic with holes in floors and ceilings
	No meeting place(s)/community area(s)
	Green areas are located to the north of the building whereas the south side overlooks the street
	No fixed designated parking

OPPORTUNITIES (O)	THREATS (T)
High potential for beautification	Anonymity of the residents due to the size of the building
Building utility and aesthetic upgrades are possible and necessary	Fear of dividing the residents of different income levels based-on a two-class model, which could happen with partial refurbishment of the building (envy, resentment, snobbery)
Potential to showcase a new building concept, to be a role model, to inspire	Lack of involvement of the existing residents in the refurbishment process could lead to distrust
Balconies are not existing, but could be added	Old plumbing supply lines at risk of bursting, compatibility to newly renovated plumbing system uncertain
Willingness of residents to change	41% of the residents are over 60 years of age

e) Structured Analysis

Furthermore, the SWOT analysis was developed using a structured analysis about social, economic and environmental topics. This was done to attain a more precise image of the living conditions in Ludwigsfeld.

1. Social Structure
- Sustained and above average share of socially deprived people (age, employment, origin)
- Increasing housing shortage due to greater than average influx into the district

Development of Residents and Forecast	• Rising population due to influx of young people (S) • Downward trend among native-born population (W) • Migration to the surrounding area as an indicator of housing shortage (T) • Compared to 2013, the neighborhood's population has increased by 8.3% (cf. city of Nuremberg: 4.4%(O) • Over 11,300 people live in the neighborhood today (S) • 7 Inhabitants per ha • 50.1%. Are male residents and 49.9% are female residents (as of 2019). • Inhabitants by marital status : single (51%), followed by married with 33%, remaining are the widowed and divorced. (O) (T) • There are 5.5% single-parent households (O) (T) • Students need affordable housing because they have lower incomes, but they prefer central, well-connected housing locations. Demand is increasing (S) (O) (T) • Trend towards household downsizing (S) (O) (T)
Age Distribution	• Number of elderly people (over 80) is rising sharply (T) • Comparatively young population due to influx of students (S) • significant aging trends in the peripheral urban districts • The growth rate of aging neighborhood residents is increasing compared to the much slower growth rate in the younger population  Small-scale population forecast 2006 – 2025 District / Population / Change 2006 – 2025 2006 / 2025 / Total (in%) / according to age groups in % 0-6 / 6-15 / 15-25 / 25-45 / 45-65 / Über 65 Ludwigsfeld 10 141 10 390 250 (2,4) -6,6 -9,8 -19,9 -0,6 17,4 14,0 Figure 1: Small-scale population forecast 2006 - 2025
Foreigners	• Rising influx from foreign-born population (S) (O) (T) • Due to the increasing number of refugees, there is a demand of long and short term accommodation (S) (O) • Percentage of people with a migration background is very high, which leads to a multicultural environment (S) • 31% of people living in Ludwigsfeld were foreign born • in the migration balance positive balance (O) (T)  Inhabitants by migration background 2015 – 2019 60 50 40 30 20 10 0 2015: 50 / 23 / 27 2016: 49 / 23 / 28 2017: 47 / 23 / 29 2018: 46 / 23 / 31 2019: 46 / 23 / 31 Germans without migration backround Germans with migration backround Foreigners Figure 2: Inhabitans by migration background 2015 - 2019
Level of Education	• Most of the people living in Ludwigsfeld are secondary school graduates (S) • Number of students is not decreasing, and thus, they compete with families and low-income households for shared apartments and housing (W) • Inflow of younger people and highly qualified workers through the universities (S)
Low Income	• 36-44% of single parents and households with 5 or more persons are at risk of poverty (T) • Number of elderly households at risk of poverty is increasing (T) • At 5.4%, single-parent households are slightly above the city's average at 4% (W) • 49,700 households in Nuremberg are at risk of poverty (W) • 20,600 single-person households are particularly in need of affordable housing (W)
Unemployment SGB II & SGB III	• The number of unemployed remains constant (S) • The unemployment rate at 5%, in 2021 (S)

2. Social Infrastructure and Culture

• Facilities in the district are not catered towards young people even though there is a university department
• Large amount of first-class entertainment facilities present, under construction or in planning

Schools and Kindergartens	• Additional important social facilities include several childcare facilities, schools for public education, and the Department of Didactics of Geography at the Friedrich- Alexander University of Erlangen- Nuremberg (S) • Nuremberg Technical University is about 5.5 km away (S)
Facilities for the Elderly	• Infrastructure provisions for older residents is limited to a residential home for the elderly; however, further nursing homes are located in neighboring districts (W) • The Historical Streetcar Depot Museum, which was opened in 1985 as part of the 150th anniversary of railway in Germany, presents the history of trams and local transportation in Nuremberg (S)
Facilities for Families	• Cultural offerings are limited to institutions such as the Meistersingerhalle and Luise-The Cultfactory (S) (W)
Supporting Community	• In order to give the district development a new cultural dynamic, a major cultural building project is being realized with the Nuremberg Concert Hall (S) • Located on the northern edge of Luitpoldhain, the Meistersingerhalle, named after the Nuremberg tradition of the Meistersinger, is the city's municipal cultural and congress center, which is currently the venue for the Nuremberg Symphony Orchestra (S) • Ecclesiastical offerings such as the Church of St. Kunigund, the Advent Parish Nuremberg, the Russian Orthodox Church, and an ecumenical working group promote religious identity in Ludwigsfeld (S)

3. Open Spaces

• Ludwigsfeld offers a large variety of places for relaxing and recreational activities
• The lack of a district center prohibits a greater feeling of community

Open Playgrounds and Sports Areas	• Small open spaces are meant for recreation and relaxation within the residential areas and include playgrounds and small fields for sports (S) • Sports facilities are distributed throughout the entire neighborhood due to the additional use of community spaces (S) • Directly in the Regensburgerstraße there is a playground (S) • The Ludwig-Frank sports facility is a 7 min walk from the building (S)
Parks and Public Areas	• In the south of Ludwigsfeld, areas for public use and green spaces open up the district towards Volkspark Dutzendteich, the largest park in Nuremberg (S) • Large green spaces, such as Luitpoldhain are used for public recreation, sports and leisure activities (S) • A community garden lot with over 30 plots is currently in place, and forms part of an essential contribution to the amenities of the neighborhood, with usable and perceptible green spaces (S) • South of Ludwigsfeld, a large pond / lake offers outdoor activities (S)

4. Real Estate and Living

• Ludwigsfeld will keep its post-war charm due to historic preservation measures
• Densification with predominately residential buildings and social housing is planned
• The district contains a majority of large residential buildings with 7 or more apartments

Real Estate	• Since 2014, more than 170 new buildings have been integrated into the Ludwigsfeld residential area (as of October 2018) (S) • In the district of Ludwigsfeld, simple, moderate or middle-class residential areas predominate, and the percentage of buildings built before 1948 is higher than in the city average (W) (T) • Over 80% of all buildings contain 7 or more apartments (W) (T) • Old buildings (up to 1948): 1,819 apartments, representing 28.3%, which is almost 7% more than in Nuremberg. (W) • Mean age of construction: 4,195 apartments = 67.7% • One or two-family houses approx. 17% lower compared to Nuremberg (W)
Building Types	• The north-east of the district is connected to the dense housing structures of the inner-city sub-districts (S) • The Rosenhofsiedlung residential estate, and several older existing buildings in the neighborhood, were placed under historic preservation, with most of these predating 1948 (T)
Potential	• Future planning foresees the construction of several, multi-story residential buildings with integrated areas for social housing (O) • Urban planning measures to (re)develop Ludwigsfeld is based on construction measures that entail the demolition of existing garages in the area and their replacement with residential buildings (O)
Living	• Price increases of residential property is very high and was 40% higher in 2018 than in 2015 (T) • The increase in renting and purchase prices exceeds the increase in income (T) • Housing costs often exceed 30% of net household income (T) • Real estate ownership is impossible for some income groups (O) • Nuremberg takes measures to strengthen lower price segments for new construction (W) • Rent for existing apartments in Ludwigsfeld ranges from € 9,45 to € 11,82 per square meter (O) • The rent increase average is 5.3% (O)

5. Traffic and Mobility

- Very good connections to public as well as individual means of transportation
- Parking is difficult at times due to a lack of dedicated parking areas
- Bicycling is a great means of transportation in the district

Connection to Public Transport	• The district has a good connection to the public transport system (city bus, tram, suburban railway) (S) • The accompanying tramway road on Regensburger street offers two centrally located stops (S) • main station is reachable by public transport in about 20 min (S) • It takes 12 min to go by subway from the main train station to the airport (S) • Thus, it takes about 32 min to get from the neighborhood to the airport (S) • There are a total of 23 public stops in the district (S)
Streets and Intersections	• Ludwigsfeld offers good connections to main roads, as well as to junctions of important highways (S) • Ludwigsfeld is bordered to the south by Bayern street (part of the Nuremberg Ring Road B4R), to the west by Münchener street and to the north-east by the Nuremberg-Munich railway line (S)
Bicycle Lanes and Infrastructure	• In the center of Ludwigsfeld, shopping facilities are plentiful and can be easily reached by public transport or by bicycle (S) • Numerous cycle lanes are available in the south (S) • Density issues prohibit bicycle infrastructure in the north (W)
Parking	• The construction of a new parking deck is currently being considered; however, this action will create the disadvantage that even more open space will be sacrificed and that an area between two existing rows of houses will be sealed off (O) (T) • The majority of the 726 parking spaces that serve a total of 1,343 apartments are public street parking (W) • The construction of the parking garage will create a total of 83 new parking spaces (O) • 534 parking spaces remain as a deficit (W)

Noise Pollution	• Busy two-lane roads with traffic in both directions (W) • Multiple railway tracks to the north and east cause noise pollution (W) • Abundance of green area between buildings diminish a measurable amount of road noise (S)

6. Work, Economy, Supply and Health

• Local shops offer employment and the convenient connection to transportation makes commuting easier

• Even though all daily necessities are provided for in the quarter, it is not a shopping destination

• Social gathering places like bars and restaurants are mostly located in the northern part of the district

Work	• The headquarters of the Federal Employment Agency (Agentur für Arbeit) is located to the southeast of Ludwigsfeld and defines the skyline of the neighborhood (S) • Employment opportunities and job training are offered by the technology company Diehl Group and several small to medium-sized businesses (SMEs), which are mainly active in the automotive industry (S) • Since 1998 employment subject to social insurance contributions has increased by 9% or 23,000 jobs (S) • Service sector (three-quarters of employees in Nuremberg) gained in importance over industrial sector (S)
Commercial space	• Buildings are typically mixed residential and commercial (O) • Buildings include commercially used halls, office buildings, production facilities, and retail (S) • The northern section of Ludwigsfeld, has few trees, greenery, and exterior elements in public spaces (W)
Supply	• Shopping facilities are plentiful in the center of Ludwigsfeld and can be easily reached by public transport or bicycle (S) • In Ludwigsfeld, mixed-use structures have been preserved. The ground-floor zone with its high public profile continues to exist with individual small retail businesses, restaurants, and a few local food supply companies (S)
Catering / Restaurants	• A large variety of grocery shops, cafes, and restaurants are located mainly in the northern part of the district, and are also easily accessible by all types of transportation (S)
Health	• A pharmacy provides medicine and supplies, and local doctors ensure medical care (S)

f) Description of Urban Issues

Urban issues in Ludwigsfeld are derived from the weaknesses and risks brought up by the SWOT analysis. Urban issues are basically all those problems and challenges that arise through, or in relation to places of residence and living in urban environments. Places of residence can define a broader environment such as an entire city, or more concretely a neighborhood, or one's own building. Urban issues arise from unique interrelationships that exist as a result of living in a densely populated environment.

A typical problem in German society is that the population is becoming increasingly older. In areas such as Ludwigsfeld, where the buildings were constructed in the 1960s and 1970s, they are often still occupied by first-time tenants that are now elderly, thus increasing the average age ratio. Whereas inner-city areas with housing for one or two-person households are occupied by younger people. The lack of young people in society has a direct relationship to private and professional choices. Although we can clearly see this development in Ludwigsfeld, the trend is far more pronounced in structurally-weak rural areas of Germany. In these areas, the phenomenon of a "rural exodus" is becoming a serious problem in some places. Ludwigsfeld is a destination for young people, especially when they move from the country to the city in order to study. However, even this is not enough to reverse the trend of an aging population in this neighborhood.

Rapid population growth accompanied with increasing social, economic and spatial heterogeneity can disrupt the social fabric and lead to conflicts or even fragment society. In the existing building, it is necessary to ensure peaceful coexistence and to promote a sense of belonging within the housing estate.

Ludwigsfeld's inability to attract enough young people is partly due to the lack of small apartments. The change in the structure of households is a nationwide trend, but is particularly strong in Nuremberg. Over time, the need for one to two-room apartments has increased dramatically, whereas the share of multi-person households has decreased. Society has distanced itself from the classic image of early marriage and offspring, and is striving for more freedom, self-determination, and individuality. The demand for single-person households is very heterogeneous and not only

haracterized by the younger population, but it is also due to the aging process of the population as a whole. The number of widowed people is rising steadily and explains the proportion of single households. The increasing number of single households means that the total number of households continues to rise, even though there are not enough apartments available for them. When looking for housing, single households and shared apartment arrangements are now competing with families, as they all demand the same type of apartment. Due to singularization processes, household growth is higher than population growth. Even if the development of the population remains constant, the demand for housing or the number of households will increase.

One major problem is that rising demand is being met by comparatively low construction activity. This is one reason why the housing market situation has become very difficult and why rental and purchase prices are also rising across all segments.
Ludwigsfeld is still characterized by a large number of unimaginative and chiefly practical social buildings from the 1950s. Even back then, these buildings only met average standards and were intended for the low-cost housing of people from the working class. This type of social housing can be found very often in the northeast and western parts of Germany. The buildings are too solid to tear down because of their adequate structures, but on the other hand, they offer little comfort and are therefore simply unattractive for new tenants. However, the lack of comfort is not the only problem. Modern amenities can be retrofitted through renovation measures, but it is rather the image that an old social housing district brings with it that puts off most people.

Old building stock is particularly energy inefficient and has too high a CO2 load due to outdated system technologies. In addition, the demand for cooling in summer is increasing in cities due to climate change. A major problem here is the lack of environmental awareness in the building sector, which does not utilize unused space with energy-saving potential.
However, social housing in itself remains an essentially important issue in Germany. Due to the extreme increase in rents on the free housing market, and an even stronger rise in real estate purchase prices, it has become even more difficult for the middle class to obtain home ownership.

A major problem is the lack of residential construction sites. However, this is not due to a lack of investment interest or the construction and real estate industries, but rather to the high excess demand. It is almost impossible to balance out the supply of housing through increased construction activity, as there are hardly any large potential areas available, and the situation on the housing market will therefore continue to tighten.
Rental prices are also rising at a rate significantly higher than the increase in salaries, so that households have to spend an ever-larger share of their disposable income on housing. A smaller remaining income also increasingly leads to poor conditions among low-income households.
The impact of not having enough social affordable housing can be seen every day, because people are being pushed out of their city as a result of rising rental prices. Growing prices make the prospect of home ownership difficult for young adults. Social construction conducted by the city's building society, which create housing on a non-profit basis, is thus necessary for keeping the population in the city.

Another urban issue is public exposure to noise from road traffic, public transport, and freight traffic. Permanent background noise causes long-term restlessness, insomnia, and nervousness. While this is an acceptable burden for some young people, there is an increasing number of older city dwellers who want to escape the restlessness of the city. They feel compelled to leave their familiar surroundings to spend their retirement in rural areas, even though their mobility and social connections will be limited. While modern cars and trains have become quieter, even running underground in many places, their numbers are on the increase in the city.

A vast majority of the population is still dependent on automobiles, even when they live in the city. This is because their place of work is often located out of town, and is difficult to reach, or cannot be reached (flexibly or fast enough) by public transport. This leads to a significant lack of parking spaces, especially in older sections and in densely populated areas of the city. Ludwigsfeld has a good connection to the transportation network, but underground garages were not considered when most buildings were originally built. Garages would be much too cost-intensive to retrofit. Street parking is usually the only type available, which means that people are faced with everyday uncertainty on their way home from work.

Finally, in neighborhoods with an above-average number of foreign-born residents, like Ludwigsfeld, there is the danger of isolation and group factions. While individual foreign-born residents tend to quickly integrate into a community, larger numbers of people coming from one origin or religion tend to form groups that become isolated from the native-born residents. The phenomenon is fueled from both sides. Foreign-born residents find it easier and more familiar to surround themselves with people of the same origin and social attitude than to deal with German culture and customs. In return, native-born residents feel less responsible for the integration of the foreign-born if they already show themselves as a group. The inhibition threshold of communication is also higher on both sides if people of different origins already feel they belong to a group.

Most people associate the affordability of housing with sharply rising costs, and so it follows that people equate housing quality with the function of cost. Some people can afford quality housing and others cannot and therefore creating affordable housing is becoming more and more important.

g) Relevance for Transformation

With the addition of new storeys and renovation, we have the opportunity to connect to existing buildings without wasting a lot of energy and materials. Human life is the focus of sustainability, so the resident's living environment is seen as a foundation and a resource that has not yet reached the end of its lifespan. Residents should feel comfortable in their surroundings, and that is why we want to preserve this feeling. We see the existing as an opportunity on which to build, thereby accommodating environmental protection. The building industry often sees conversion and renovation as a complex problem and prefers demolition, which is often purely a financial decision and a careless one at that.

Cities are the engines for interests, exchange, innovations, hope, and conflicts. The challenge is that the neighborhood and its existing structures need to be further developed. Various modernization measures such as renewable energies, alternative mobility concepts, and eco-building open up new investment opportunities for various construction companies and tenants with purchasing power. Eco-capability not only affects the future of the planet, but also the residents themselves: contact with nature through sufficiently accessible green and open spaces, and in our case a green roof is essential for well-being and health and can enhance the quality of life. A neighborhood that has invested a lot in development and modernization can improve its image for the better. The residents described above, who live in the neighborhood, have a positive attitude towards their own surroundings and for this reason further tenants also see a future in the area.
Based on the specific demand to attract young people to Ludwigsfeld, the neighborhood can benefit from interesting, innovative, or unusual apartments and housing concepts. The young generation, in particular, tends to be more willing to experiment, and is especially attracted to housing designed for their needs. Notably in the areas of social cohabitation and ecological sustainability, younger generations value efforts that are made on their behalf.
However, there is a particular need for action when considering the creation and supply of small apartments for singles, couples, and small households. Using renovation measures, room layouts of existing buildings can be adapted to current needs, thus creating more apartments on the same floor slab. Utilizing clever furnishings, smaller apartments can create comparably pleasant living spaces, and offer residents greater financial leeway through lower rental costs.

Of course, modernization also has other benefits for residents, such as lower utility costs due to efficient heating and insulation, as well as effective sound insulation through modern windows and green facades.

Furthermore, Ludwigsfeld can also serve as a model for other innovative modernization measures in the region, and by demonstrating the effectiveness of these measures, can even convince decision-makers to invest in similar residential areas on a larger scale.

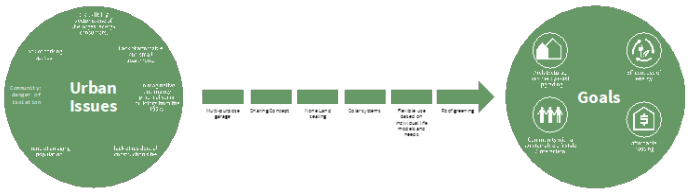


Figure 3: Urban Issues & Goals

37.2 Definitions

a) Full Definition of the Social Scenario & Urban Issues

The current tenants, who can be assigned to the Sinus Milieu, can rather be classified as traditional and lower middle class. Among others, there is the traditional milieu, which adheres to anti-individualistic thinking, social forms and moral concepts. There are also residents who are classified in the precarious milieu. In addition, residents belong to the middle class, who affirm the social order and strive for professional and social establishment as well as secure harmonious relationships. Future residents can be assumed to strive for a different basic orientation and to be classified in a somewhat higher class. The residents classified in the adaptive-pragmatic milieu are the determined, mobile young middle class. They are success-oriented, willing to compromise and have a strong need for flexibility and security. Likewise, there are residents who can be assigned to the hedonistic milieu. They are generally characterised by living in the here and now and belong to a fun-oriented, modern lower class or lower middle class and accordingly have little control and planning. Future residents also include the socio-ecological milieu, which is characterised by idealistic, consumption-conscious behaviour and globalisation scepticism. It is characterised primarily by a pronounced ecological and social conscience. Overall, a rather heterogeneous picture emerges among the residents. Also with regard to different age groups and family statuses, everything is given in the existing building. Ludwigsfeld is part of the inner-city belt and its inhabitants thus have an estimated €22,000 per year, which rather corresponds to a lower purchasing power. In contrast, rents for existing flats are

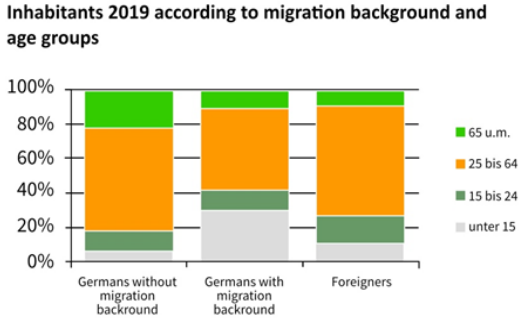


Figure 4: The inhabitants in Ludwigsfeld can be divided according to migration background and age groups

The need to renovate existing buildings and add storeys to them is based on the following principles and provides concrete approaches to solving urban and current problems: Within Europe, the building sector is one of the largest energy consumers, consuming about 40 % of energy and emitting 36 % of all CO2 emissions. The EU's ageing building stock (around 35 % of buildings are 50 years old or older) contributes to around 75 % of buildings being classified as energy inefficient. In order to achieve the climate policy goals, the current building stock in the EU needs to be transformed into a nearly climate-neutral condition by the year 2050. These targets require energy modernization, as 90 % of building energy demand is attributed to buildings build before 2000. In households, the following degrees of self-consumption are possible (guideline values): with optimised household appliances, a savings of 30-40% can be achieved, with additional heat generation up to 60%. In order to address the increasing demand for affordable housing at the same time, the addition of more storeys to existing buildings is required. Already 77.3 % of the German population lives in cities, and the trend is rising. Multi-family houses from the 1950s – 70s represent the largest segment of the German building stock. They often consume large amounts of energy and are in dire need of renovation. The energy modernization and addition of storeys, with an energetic plus balance (counteracting energy poverty) of corresponding buildings, offers vast potential to achieve a measurable contribution to the climate neutrality of the building stock. Furthermore, it also helps to create affordable housing without building on more green-field spaces (reduction of land consumption). Renovation and additions to existing buildings have the greatest potential in the urban energy transition. The creation of new and affordable housing can increase the urban population density in the long term. In this context, a socially equitable diversity among residents and at the neighbourhood level is supposed to have a beneficial effect. Social interaction and a lively neighbourhood promote togetherness in the long term and increase the tolerance of the residents (prevention of social isolation). In addition, mixed neighbourhoods and neighbourhood assistance enable a dynamic development of the district. Gained common areas (integration space for joint use and cooperation) counteract defensive attitudes and conflict theory and ensure better togetherness, as well as a learning process and understanding towards other residents. Despite the newly created meeting places, the socially acceptable architecture still allows for individual living, i.e. the adaptation of the residential units to the needs of the residents. The advantages of a social mix in urban neighbourhoods reinforce the selected scenario and the urban planning situation:

- Learning from "others" in the direct living environment
- Less discrimination and fewer reservations
- Less "loneliness" of single households
- Neighbourhood help
- Counteracting rising social inequality
- Increasing Solidarity; willingness to see themselves as one community
- Compensate the weaknesses of individual residents
- New social creativity
- Collaboration of young and old residents
- Learning to share with our Sharing-Concept (compare to 37.3 a)
- Taking responsibility

b) Definition of the Strategic Objectives

We create practical, innovative and future-oriented solutions for affordable housing in urban areas. To counteract the urban housing deficit in Germany - in our urban context using Nuremberg as an example - we are developing a modular, two-storey addition including roof gardens and communal areas in lightweight timber construction with a high degree of prefabrication to reduce construction time and costs to a minimum. The goal is to use sustainable, energy-efficient and socially acceptable architecture to advance the energy transition in urban neighbourhoods and create sustainable cities. Newly created meeting places in the neighbourhood strengthen the residents' sense of social community, reduce disagreements between residents and counteract the loneliness of single households. Nevertheless, flexible and modern architecture allows for individual use and adaptation of the flats to different lifestyles and needs of a large social diversity. For this reason, all flats in the existing building and the addition of storeys are barrier-free. The innovative concept is intended to enhance German city centres not only architecturally and aesthetically, but also socially. Furthermore, the focus of the addition is on recyclable construction made of renewable, biogenic, CO2-absorbing building materials like wood and recycled and recyclable materials. Addressing the largest building stock in Germany, from the 1950's - 1970's requires the achievement of multiple synergies. For instance, additions need to be adaptable to nearly all of the different floor plan types of buildings from this period, and modular so that additions have the capability to be detached from the statics of the existing buildings. We have developed a transferable and transparent solutions for all German cities with our concept. The process of designing a multi-storey extension has given us the opportunity to develop renovation plans for the existing building without far-reaching restrictions for the existing residents. By doing so, we have counteracted currently high energy consumption in the buildings. We aim to reduce CO2 emissions and achieve required climate policy goals by maximizing our own electricity production at the building and in the neighbourhood (sector coupling). Energy refurbishment and electricity and heat procurement will be achieved exclusively through a sophisticated energy concept and renewable energy. The existing building and the addition are designed as energy-plus buildings, and therefore function as a power plant. This also makes it possible to focus on sustainable e-mobility while at the same time reducing individual transportation through sharing offers and alternative forms of mobility (e.g. cargo bikes). We are also developing a neighbourhood parking garage to counteract the current parking problems in Ludwigsfeld. Mobility services can be booked in a user-friendly neighbourhood app specially developed for smartphones. A lively residential environment with diverse interaction between residents does not come out of nowhere. For this, supportive offers

are necessary that contribute to the formation of the community and to identification with ones place of residence. Meeting places such as our green roof or community garden provide this necessary space and promote a sense of togetherness among the residents. The community garden can be shared and is thus better utilised and more efficient. In addition, the exchange of goods and services in our sharing app is intended to stimulate and promote personal contact among residents from different social classes, hierarchical levels, different mother tongues and across generations. The neighbourhood support system benefits from the social diversity of future residents. When residents identify with their neighbourhood, it strengthens the community. They pay more attention to their surroundings, which in turn is a good basis for leading an energy and climate-friendly lifestyle. By taking on social services or even performing environmentally friendly behaviour, residents can earn virtual currency in the app, which has a positive financial impact for the residents.

In summary, the strategic objectives can summarised: compare to CESA Report 38.3 Strategic planning c) Messages: Vision and positioning our communication

37.3. Concepts

a) Concept for Affordability & Viability

1. Focus on residents

1.1 Effects on customary local rents & Affordability

The local comparative rent indicates the rent to be expected for rented flats in the neighbourhood in question. It is essential that the buildings used for the comparison are comparable in terms of type, size, equipment, condition, and location. The 'middle value' of these amounts corresponds to the rent customary in the locality. For the calculation (can be found in Appendix), the monthly basic net cold rent in euros per square metre by living space is taken from the rent index 2020. Criteria such as age of construction, location, etc. are taken into account by means of additions and deductions as a percentage of the basic net cold rent. Special features that increase or decrease the housing value and are not covered by the surcharge/deduction system, as well as a feature quality that deviates from the standard in the surcharge/deduction features, can be taken into account within the range. In Nuremberg, this is +/ - 22 % around the average local comparative rent (middle value). The rent of a flat is generally considered to be customary in the locality if it lies within a range in which two-thirds of all rents in this flat class are likewise located. The square metre figure for the living space can be found in our plans. For both flats, the calculations have shown that the rental price of existing buildings of ca. 9.45 €/sqm – 10 €/sqm is between the middle and upper value. The rent is considered customary in the locality, as it lies within the range.
Our aim is to prevent rental costs from increasing due to the renovation and addition of storeys. Financial gains derived from rents collected from the added apartments in the addition of storeys will be used to finance the overall renovation costs. Furthermore, utility costs will be permanently reduced by the added-value and long-term savings of the energetic renovation.

1.2 Effects on operational costs & affordability or the residents

Our energy concept offers potential savings in operating costs for its residents in several respects.

On the one hand, heating costs are reduced by a ventilation system with heat recovery. This preheats the fresh air before it enters the rooms. This means that window ventilation is not necessary in winter. Secondly, the façade activation pre-conditions the old building stock. As a result, the old radiators in the flats can be operated with lower flow temperatures. In order to reduce the costs for electricity and water heating, various PV and PVT modules are used. These not only supply a high proportion of electricity for the operation of the building, but are also designed in such a way that no additional energy and associated costs are incurred for water heating in summer. Furthermore, the heat from the hot wastewater is transferred to the cold water via a heat exchanger in the shower channel. This preheating means that the drinking water only needs to be reheated in the water heater. At the moment, the purchase costs for such a shower channel are relatively high. This will improve considerably in the future, as this technology is on the rise in Germany and will therefore only be produced in large quantities in the future. Furthermore, operating costs are saved by passively intervening in user behaviour in the use of energy and resources. For example, a hand shower is installed in the shower (Hansaactivejet Digital), which has a digital display. The energy and water consumption, as well as the water temperature, can be read there in real time. Thanks to its Bluetooth capability, this shower can communicate with an app that compares the water and energy consumption of the residents and thus creates a small competition among the residents. This is to encourage saving. By scanning QR codes at the water taps and the household appliances, the app also provides tips on how to make everyday life more resource and energy efficient. Water is not only to be saved through passive measures, but also through active measures. For example, the wastewater from showers and washbasins is purified in a greywater system similar to a sewage treatment plant and reused as service water for flushing toilets and washing machines. Just like the passive measures, water recycling has a positive impact on water consumption and thus on ancillary costs. Furthermore, collecting and using rainwater for watering the greenery has financial benefits for the users.

In general, our aim is not only to encourage residents to adopt climate-friendly and economical behaviour in the home, but also to permanently reduce ancillary costs and counteract the waste of energy and water.
According to the Federal Environment Agency, water consumption in litres per inhabitant per day was 127 l/E*d in 2018. In 2020, it was even 129 l/E*d. Of this, ¾ of the water is used for personal hygiene, washing clothes and flushing toilets. In this area, grey water can be obtained without much filtering, namely from the waste water

from personal hygiene. The purified greywater can be used as so-called process water for washing clothes and flushing toilets. By operating the washing machine and flushing the toilet with the purified grey water, 39% could thus be saved, which is approx. 49L per day and per capita. With the intelligent interaction on grey water and rainwater, we can cover the entire water consumption in the addition of toilet and washing machine without drinking water. Calculation can be found in Appendix.

	Water Consumption	Water fees
Average value	129L	183€
With levelup	80L	125€
Savings	49L	58€

For the ancillary costs there are further figures:

	electric				thermal	
Month	PV-Generation AC [kWh]	Own consumption [kWh]	Mains supply	Grid feed-in [kWh]	Total useful thermal energy [kWh]	Total final thermal energy [kWh]
January	22061,00	11001,00	31012,77	11060,00	22412,00	12424,22
February	30510,90	14553,00	22987,34	15958,00	18124,00	9857,11
March	45435,70	21995,00	17548,82	23441,00	9178,00	4843,44
April	55611,80	23518,00	11725,60	32094,00	5277,00	1806,00
May	65573,20	24872,00	9643,76	40701,00	5393,00	639,00
June	62478,50	23462,00	7535,47	39017,00	4633,00	408,00
July	68977,70	22787,00	6431,76	46191,00	3678,00	46,10
August	60440,20	22522,00	8576,71	37918,00	4298,00	350,00
September	51802,40	20261,00	10936,65	31541,00	4402,00	1245,00
October	38012,20	17234,00	16934,32	20778,00	4716,00	2455,22
November	23019,10	13117,00	23307,64	9902,00	15599,00	8985,67
December	17488,80	10361,00	30253,64	7127,00	23922,00	13184,89
Σ	**541411,5**	**225683,00**	**196894,49**	**315728,00**	**121632,00**	**56244,66**

For heat, the useful energy is the energy that the building needs and the final energy, the actual purchase of district heating. Looking at the grid feed-in (315728), it becomes clear that the building generates more electricity (541411.5) than it actually consumes (225683). For each kWh supplied, we receive a legally fixed amount known as the feed-in tariff. This enables us to generate profit and at the same time contribute to climate neutrality. On average, 1911.60 kWh are consumed per flat (196894 kWh Mains supply/ 193 flats). The average annual consumption is between 2000 kWh and 3000 kWh. This shows very well that we use much less electricity and can therefore also significantly reduce the costs, which depend on the electricity provider. Likewise, the heat per flat amounts to approximately 546.06 kWh (56244.66 kWh/ 103 flats).

1.3 Sharing Concept

The idea of sharing and bartering are already deeply embedded in humanity. Only the pace, the scope and the way are constantly changing. We would like to support a sustainable and resource-saving way of life with our sharing concept. Our concept will be anchored in an app, in which cars and bicycles will be available for booking and bebilled using a points system. (explained in more detail in Urban Mobility Report in 4. Mobility Concept). The car-sharing concept aims to reduce the number of cars per resident and the associated traffic density and serves as an incentive for carpooling between residents.

Basically, the app is necessary to implement the wide-ranging concept. Here, the booking of services, goods and cars is done with just a few clicks and one has all the necessary information for the pickup, delivery and return clearly at a glance. With an integrated calendar, one can check availability and view bookings. There is also an automatic age check and billing via a points system (explained in more detail in Urban Mobility Report in 4. 3 Point System). The goal of the app's design is to provide residents with the clearest and simplest operation possible, thus promoting exchange and interaction between residents. Recognizing that the social aspect is particularly important, a concept has been developed that especially supports the elderly and/or singles by actively bringing them into the community network.

The car sharing concept is explained in more detail below.

The offer is intended to be a cost-effective alternative to local transportation and in the best possible way to meet the needs of residents. At the end of the term, the vehicles will have paid for themselves, but will not have generated a profit. If a profit is nevertheless made, it will be reinvested in the purchase of new vehicles and the pricing model for residents will be adjusted accordingly. The desired result is a clearly defined vehicle pool (vehicle type and number) and an associated pricing model (price/km and price/min for respective vehicles). The vehicle pool must be adapted to younger and to older age groups, since young inhabitants tend to have a lower payment capacity than older ones. Our pool includes bicycles, e-bike,s cargo bikes, cargo tricycles, Renault Zoe (small car), VW ID3 (middle class), and a Mercedes EQA (upper class) in order to cover a range of vehicle types. Doing so, we provide an option for each social class so that we can counteract disputes among residents regarding the means of transportation used.

Cost calculations are an important point for the selection of vehicles. For cars, a leasing contract (term: 2 years) and for bicycles, the purchase (expected useful life: 5 years) proves to be a sensible solution. In addition to the procurement costs for the vehicle and

Type	TC/m	TC/SL
Bike	63,22€	3.792,92€
E-Bike	127,75€	7.664,97€
Cargo bike	151,64€	9.098,49€
Cargo tricycle	133,81€	8.028,67€
Renault	660,50€	15.851,92€
VW	768,94€	18.454,44€
Mercedes	988,73€	23.729,52€

over the service life, which lead

Allocating vehicle costs to a price/km and price/min must be accomplished in such a way that the concept neither makes nor losses profits. Therefore, it must be calculated on how far the respective vehicle is likely to be moved annually (mileage) and the length of its loan. In addition, the relationship between the prices must be determined, because the mileage cannot be technically recorded for bicycles. In this case, the costs are allocated at 100% to the price/min. Analyses have shown that a 50/50 composition is the most favourable choice for future car users. The prices are calculated as follows:

Costs/km = Costs per year/Mileage * Price share mileage
(50% car, 0% Bike)

Costs/min = Costs per year/Mileage * Loan period
(50% car, 100% Bike)

Type	TC/m	TC/SL
Bike	-	0,01€
E-Bike	-	0,02€
Cargo bike	-	0,02€
Cargo tricycle	-	0,02€
Renault	0,19€	0,03€
VW	0,23€	0,03€
Mercedes	0,29€	0,04€

Further evidence of the benefits of the sharing concept is considered to be the potential car savings achieved if all residents switch from privately owned vehicles (POVs) to the sharing pool. The stock can be reduced from 161 vehicles to 33 by means of the sharing concept. This corresponds to a savings of 131 vehicles or an 80% reduction. The vehicle density would thus be reduced to 8.25 cars per 100 inhabitants. Depending on electricity generation, a significant CO2 emission reduction can be achieved. For example, using a VW E Up charged with the grid mix, or even with photovoltaically generated electricity, saves 52 g CO2 per km or 94 g CO2 per km compared to a reference vehicle equipped with an internal combustion engine (ICE).

In addition to the advantages, which can be found in the Urban Mobility Report in „4.5 Extended functions“ under „Advantages at a glance“, the concept also points out possible negative issues:

One legal issue concerns the driving licence check, e.g., if the client i.e. resident drives without a valid driving licence. In this case, the levelup team would currently be liable for any accidents or injuries. Since it is not possible for house owner to access the driving licence database, and self-disclosure is too risky, we would like to counteract the control issue by having the property management act as administrator. In this scenario, the administrator would create a user's account for all residents that have recently moved in, and personally check the validity of each of their driving licences. The next issue arises if the driver has been forced legally to hand in their driving licence. In this case, checks would have to take place on a regular basis and/or residents would be contractually required to declare changes in the status of their driving licenses. Limited independence caused by tardy returns from previous vehicle borrowers is yet another critical point that needs to be addressed. One possible approach to prevent is to charge penalty points for late returns that surpass the foreseen 15 minute buffer time. If there is still a delay, a points deducution would be conceivable. Furthermore, disputes can arise over the car to be rented, as a certain model is particularly favoured over another model. Furthermore, disputes can arise over the car to be rented, as a certain model is particularly favoured over another model. If this were to happen, a weekly booking limit would be conceivable. Residents, especially the elderly, might have doubts about allowing their personal data to be used, stored and saved for the app. The history of past activities saved in the app's preferences bring up legal issues that need to be addressed. When sharing items, the question of liability arises if the borrowed item is damaged or demolished. In the event of damage caused by non-contractual consumption, the hirer‘s liability shall be governed by the general law on compensation for damages. According to § 599 BGB, the lender is only responsible for intent and gross negligence. Furthermore, in the event of damage to the hirer, the lender must pay for the damage(s) if he/she have fraudulently concealed a defect in the item, § 600 BGB.

2. Focus on property owner/ investor
2.1 construction costs

The costs for the electrical installation for the addition, which includes 42 housing units, amount to €1.211.323,12 (appendix: Zeus Elektroinstallationen). Each residential unit is composed of a total of 4 individual modules. Specifically, these are 2 modules per floor. The electrical maintenance costs for the addition, according to cost group 440 electrical installations, 450 telecommunications and information technology installations and 400 building installations, amount to 40.036,34€ annually (cash value of replacement procurement) and extrapolated over 25 years, 1.000.908.49€ must be invested in maintenance. Detailed accounting methods can be found in the appendix.

CG 300	Addition 1st + 2nd level	3.872	qm	x	1.454 EUR / qm =	5.629.264
CG 300	Addition to roof	2.384	qm	x	901 EUR / qm =	2.148.890
CG 300	Carrier level on stock	1.868	qm	x	155 EUR / qm =	289.540
CG 300	Façade elements on existing façade, incl. new windows	3.972	qm	x	452 EUR / qm =	1.796.575
CG 300	Arcades + stairs for addition 1st + 2nd level	735	qm	x	1.203 EUR / qm =	884.205
CG 300	Other balconies, arcades, staircases, lift shafts	1.064	qm	x	1.203 EUR / qm =	1.279.992
CG 300	Reinforcement of foundations	148	m	x	1.795 EUR / qm =	265.660
CG 300	Conversion measures for existing staircases	5	Stk	x	66.810 EUR / qm =	334.052
					Total CG 300:	12.628.178

CG 400	Addition	3.872	qm	x	301 EUR / qm =	1.164.234
CG 400	Technology Balconies, arcades, stairs	1.064	qm	x	40 EUR / qm =	42.560
CG 400	Lifts	5	Stk	x	65.130 EUR / qm =	325.650
CG 400	Additional costs for standard PV modules façade	1.986	qm	x	288 EUR / qm =	571.968
CG 400	Additional costs for standard PV modules Roof	1.054	qm	x	347 EUR / qm =	365.738
					Total CG 400:	2.470.150

Total KG 300+400:	15.098.328
Living space addition:	2.520
Cost addition:	10.381.793
Addition per sqm LS:	4.120
Existing living space:	4.450
Costs for renovation of existing buildings:	3.453.180
Stock per sqm LS:	776
Total living space:	6.970
Costs allocated to overall building:	1.263.356
Stock per sqm LS:	181

2.2 Financing plan

There are no acquisition costs, as the housing association already owns the building. The ancillary construction costs amount to 15% and thus amount to 2,264,749.20€. The capital requirement to be financed is 17,363,077.20€. The rent consists of 9,50€/ sqm and is extrapolated to 12 months and a total of 6.385 sqm usable area (727,890€). Maintenance costs in this case are estimated at 105,000€ per year. This financial plan is based on financing with outside capital, which in this case is provided by a bank loan. Financing through the Kreditanstalt für Wiederaufbau would also be an option, but this type of financing has been discontinued by the state for the time being. This financing enables the investor to generate a profit in the 29th year. If the maintenance costs are higher than estimated, e.g. 150,000€the investor generates a profit in the 32nd year (appendix).

Assuming that the (cold) rent would be increased from 9,50€ to 10,50€, rental income would be 904.510€, maintenance costs 105.0000€ and cash flow 699.510€, a profit would be possible in the 25th year (appendix)

Current payments			
Rental income annually	727.890,00		
Maintenance costs annually	105.000,00		
Cash inflow	622.890,00		

Capital

Input	
Acquisition costs	0,00
Renovation costs	15.098.328,00
Incidental building costs (15%)	2.264.749,20
Total capital requirement	17.363.077,20
Equity capital Siedlungswerk	500.000,00
Equity capital	1.500.000,00
Total equity capital	2.000.000,00
Debt capital requirement	15.363.077,20
Credit amount credit 1	15.363.077,20
Nominal interest credit 1	0,01

Repayment loan 1

Year	Credit amount at the beginning of the year	Annuity	Interest rate	Repayment	Loan amount year end	Remaining cash flow
1	15.363.077,20	622.890,00	153.630,77	469.259,23	14.893.817,97	0,00
2	14.893.817,97	622.890,00	148.938,18	473.951,82	14.419.866,15	0,00
3	14.419.866,15	622.890,00	144.198,66	478.691,34	13.941.174,81	0,00
4	13.941.174,81	622.890,00	139.411,75	483.478,25	13.457.696,56	0,00
5	13.457.696,56	622.890,00	134.576,97	488.313,03	12.969.383,53	0,00
6	12.969.383,53	622.890,00	129.693,84	493.196,16	12.476.187,36	0,00
7	12.476.187,36	622.890,00	124.761,87	498.128,13	11.978.059,24	0,00
8	11.978.059,24	622.890,00	119.780,59	503.109,41	11.474.949,83	0,00
9	11.474.949,83	622.890,00	114.749,50	508.140,50	10.966.809,33	0,00
10	10.966.809,33	622.890,00	109.668,09	513.221,91	10.453.587,42	0,00
11	10.453.587,42	622.890,00	104.535,87	518.354,13	9.935.233,29	0,00
12	9.935.233,29	622.890,00	99.352,33	523.537,67	9.411.695,63	0,00
13	9.411.695,63	622.890,00	94.116,96	528.773,04	8.882.922,58	0,00
14	8.882.922,58	622.890,00	88.829,23	534.060,77	8.348.861,81	0,00
15	8.348.861,81	622.890,00	83.488,62	539.401,38	7.809.460,43	0,00
16	7.809.460,43	622.890,00	78.094,60	544.795,40	7.264.665,03	0,00
17	7.264.665,03	622.890,00	72.646,65	550.243,35	6.714.421,68	0,00
18	6.714.421,68	622.890,00	67.144,22	555.745,78	6.158.675,90	0,00
19	6.158.675,90	622.890,00	61.586,76	561.303,24	5.597.372,66	0,00
20	5.597.372,66	622.890,00	55.973,73	566.916,27	5.030.456,38	0,00
21	5.030.456,38	622.890,00	50.304,56	572.585,44	4.457.870,95	0,00
22	4.457.870,95	622.890,00	44.578,71	578.311,29	3.879.559,66	0,00
23	3.879.559,66	622.890,00	38.795,60	584.094,40	3.295.465,25	0,00
24	3.295.465,25	622.890,00	32.954,65	589.935,35	2.705.529,91	0,00
25	2.705.529,91	622.890,00	27.055,30	595.834,70	2.109.695,21	0,00
26	2.109.695,21	622.890,00	21.096,95	601.793,05	1.507.902,16	0,00
27	1.507.902,16	622.890,00	15.079,02	607.810,98	900.091,18	0,00
28	900.091,18	622.890,00	9.000,91	613.889,09	286.202,09	0,00
29	286.202,09	622.890,00	2.862,02	286.202,09	0,00	333.825,89
30	0,00	622.890,00	0,00	0,00	0,00	622.890,00
31	0,00	622.890,00	0,00	0,00	0,00	622.890,00
32	0,00	622.890,00	0,00	0,00	0,00	622.890,00
33	0,00	622.890,00	0,00	0,00	0,00	622.890,00
34	0,00	622.890,00	0,00	0,00	0,00	622.890,00
35	0,00	622.890,00	0,00	0,00	0,00	622.890,00
36	0,00	622.890,00	0,00	0,00	0,00	622.890,00
37	0,00	622.890,00	0,00	0,00	0,00	622.890,00
38	0,00	622.890,00	0,00	0,00	0,00	622.890,00
39	0,00	622.890,00	0,00	0,00	0,00	622.890,00
40	0,00	622.890,00	0,00	0,00	0,00	622.890,00

An additional financing option would be real-estate crowdfunding. Instead of a single person or entity investing a large sum of money to build, renovate, or purchase, a large number of individuals each make a smaller contribution to do the same thing. Depending on what is agreed upon, the crowdfunding investors earn returns corresponding to the amount they invested. Once the project is completed, each investor receives their investment back plus the predetermined interest. Investing in real estate is a worthwhile business, but in its current form it has a decisive disadvantage: in order to truly be able to participate as an investor in the development of the respective project, very high individual investments are required or need to be settled with a financial lender. Alternatively, An additional financing option would be real-estate crowdfunding. Instead of a single person or entity investing a large sum of money to build, renovate, or purchase, a large number of individuals each make a smaller contribution to do the same thing. Depending on what is agreed upon, the crowdfunding investors earn returns corresponding to the amount they invested. Once the project is completed, each investor receives their investment back plus the predetermined interest. Investing in real estate is a worthwhile business, but in its current form it has a decisive disadvantage: in order to truly be able to participate as an investor in the development of the respective project, very high individual investments are required or need to be settled with a financial lender. Alternatively, there is the possibility of paying into a real-estate fund. In this case, the return normally depends on general market development and conditions, the skill of the fund management agency, and last but not least, the „administration costs“ of the fund. The concept of real-estate crowdfunding, allows us to create an alternative that permits the investor to follow their project(s) closely in real time, even when dealing with smaller investment amounts - and with a fixed interest rate from the outset.

In order to make the real-estate crowdfunding concept transparent and easy to access, a website would have to be created where people can participate. As a rule, a minimum, fixed investment amount would be required. The website would also keep investors up to date throughout the construction phase, as well as providing current news concerning project development milestones.

Crowdfunding has some obvious advantages:

- Provides detailed information before project decisions are made
- Assures a very high level of security, based on approval of bank financing and planning permission
- Guarantees attractive interest rates
- Tracks the entire project development up-close
- Supports participation in sustainable projects

2.3 Effects on unit value

Wear and tear, damage or energy systems that are not up to date have a negative effect on the market value of a property over the years. In addition to value maintenance, there are opportunities to increase the value of the property beyond its current value through renovation, modernisation and additions, which is desirable in the event of a sale.

The value of a property can be increased with green roofs and green facades. The Global Garden Report 2011 shows that the corresponding properties in Germany have an average increase in value of 18%. The influencing factors for the increase in value are the high-quality, well-kept and decorative garden design and, in addition, the garden is seen as a social aspect (relaxation and recreation). A visually attractive appearance on the outside is the visiting card of the house. This also applies to the newly installed windows. With the replacement of the windows, the ventilation system can be integrated as a modern function. All this ensures safety, comfort, and energy savings through improved thermal insulation values. This increases the value and can lead to better rentability. In addition to the installation of new windows, the insulation of the façade is considered an energetic refurbishment and this can achieve the greatest energy-saving effect and thus also increase the quality of living or the market value by approx. 20-30%. The underfloor heating installed in the extension also increases the value, as the low flow temperature saves energy and contributes to the energy balance of the building. Basically, the technical standard of the property is of particular importance for the increase in value. With renovation and addition of storeys, we focus on modernisation and energy efficiency and can permanently increase the value of the building with all the appropriate measures. The additional living space as part of the addition of a storey, in conjunction with the modular construction method, not only creates more space, but also brings an enormous increase in value, as it offers a new source of income when the new living space is rented out, and in addition it offers possibilities for change in the room layout. Accessibility can also lead to an increase in value through flat conversion, in addition to opening new groups of buyers. The garage and the sharing concept increase the market value. A garage is an important decision criterion for many prospective buyers, and the sharing concept appears attractive because it is not yet common. All measures have a clear value-enhancing effect and make it possible for our building to stand out from other „competitors“.

2.4 Operating model

The Business Model Canvas describes the structure of the business model on the basis of nine components and offers a representation of how a company functions as an organisation. On the one hand, it is intended to provide clarity in the analysis phase and, on the other hand, to form an innovative starting point for the creative development of new business models. In the following, a distinction is made between housing companies and housing initiatives.

1. Users

The users represent the residents. Each organisation serves one or more demand groups. In our case, we offer housing for different

population groups, regardless of age, origin and financial status.

2. Value proposition
The basic requirement of our system is the creation of affordable, quality, climate-neutral and communal housing. This applies to the existing stock and additions. Our services close to home, such as the community gardens, the sustainable mobility concept, and the sharing concept as a service and supply offer, go beyond the „basic package". In addition, we create an efficient energy concept to realise a lower energy demand. The flats can be flexibly adapted to the individual lifestyles and needs of different population groups.

3. Channels = external relations
External relations can be divided into the planning phase, the construction phase and the residential phase. The planning phase mainly concerns the recruitment of residents. Common measures include using social networks or brochures that provide information about the project. During the planning phase and construction phase, contact must be established with project managers, architects and construction companies. External relations are most developed in the housing phase. The provision of communal services (whole sharing concept, community gardens) can meet with demand and interest in the neighbourhood. In the residential phase, the maintenance of the housing stock has to be taken into account. Depending on the housing market situation, residents are recruited via rental portals or social networks, as vacancies should be avoided.

4. User relations
The relationships between residents and the extent to which they are contacted vary greatly depending on the size of the housing company or housing initiative. The sharing concept already promotes exchange among residents, but there are additional possibilities such as tenant and neighbourhood festivals, newsletters, notice boards or tenant information events.

5. Sources of income
Investors usually rely on a mix of equity and financing with outside capital. Revenues are derived from rental income. Indirect revenues are generated through subsidies.

6. Key resources
Key resources can be divided into physical, financial, human and intangible. The physical resource is the existing building and the planned garages as well as the community gardens. The financial resources are the funds provided from own resources, especially for the construction. The key human resources are the professional staff, such as the management, administration and caretaker. The most important intangible resources are guiding principles or other agreements on living together, on the use of the residential properties and on the management of resources.

7. Key activities
Our key activity is the provision of housing (basic requirement). Housing initiatives invest in the maintenance of existing housing stock, i.e. maintenance and renovation/modernisation. Housing initiatives invest by acquiring space and/or properties. New construction, conversion and/or renovation/modernisation. Key activities are not only related to housing, but also to the provision of various services (enthusiasm requirements). In general, it includes creating housing with the services, building and maintaining relationships and reaching out to the housing market.

8. Key partnership
The organisation of a business model also requires cooperation in a functioning network. The network partners differ according to the status of an investment object. In the planning phase, partnerships exist with actors involved in the project, such as project managers, architects, lenders and administrations. Residents are another key partnership, with contacts planned or already in the process of being established. In the housing phase, changes occur and communication service providers and utilities/disposal companies become partners. Housing initiatives have a strong local and supra-regional character. In comparison, housing initiatives are more tied to regional networking.

9. Cost structure
Costs depend on planning status and housing status. In terms of cost structure, a distinction must be made between housing companies and housing initiatives. Housing companies, as owners, have to pay for house management (maintenance, running costs, modernisation) and possible administration costs. The cost structure of housing initiatives cannot be assessed concretely, but they tend to have lower administrative costs because tasks are rarely passed on to external parties.

b) Concept for Social Viability

Focus on the Urban Context
1. Solving urban issues
Housing is a foundation of human life. It is a fundamental right that adequate and affordable housing be made available for everyone, but in reality the implementation of this is very different. Let us make it a priority! In Nuremberg, just as in most large German cities, there is a shortage of affordable housing. The neighbourhood of Ludwigsfeld is not excluded from this statement. The proposed modular „levelup" system can significantly increase the density of neighbourhoods by creating additional living space. The modular system allows for adaptation to individual ways of life and the various needs of different population groups. This means that housing can be created for everyone - whether poor, rich, young or old. We want to counteract inequality and move away from the idea that housing is much more a privilege than a right. „Levelup" can be applied to almost all buildings in the neighbourhood, which would lead to a significant increase in living space. This could even be accomplished without building upon undeveloped green areas - on the contrary - by integrating roof-top gardens and green roofs, the percentage of green space can be increased in urban areas. This will generate positive effects

for neighbourhood cooling, water storage during heavy rain periods, the increase of biodiversity, and enhanced local recreation and leisure activities. The redesign and added value of existing, poorly-utilized green spaces in the neighbourhood could result in the creation of children‘s playgrounds, meeting areas with seating, installation of sports equipment and playing fields, and urban community gardens. There is currently a lack of parking spaces in the neighbourhood, and residents are not entitled to allocated parking spaces. The increased number of residents will also enlarge the need for mobility. A parking garage is to be built in the neighbourhood for this purpose. The garage will be located in the immediate vicinity of the existing building, and can be reached quickly and easily on foot. The garage will without a doubt support our mobility concept, by serving as the main parking area for all our vehicles and primary charging stations.
(read more in ….).

2. Neighbourhood Support

The Siedlungswerk Nuremberg expressly wishes to improve social interaction and increase a sense of community among the residents in the neighbourhood. By creating opportunities for people to gather and meet in open areas, such as the communal areas of the addition of storeys, lacking social spaces will be generated. This will hopefully counteract social isolation. Of course, it is important that one’s own residence is cosy and that one feels comfortable, but the surrounding area and the neighbourhood also makes an important contribution. Our concept promotes a sense of community and allows leisure time to be organized in a variety of ways, which will have a positive effect on the image of the neighbourhood. The new garage offers added value, because residents may park at a reduced rate if they share a car with other residents - with shared electric cars even receiving free parking. Similar offers should encourage residents to use our car-sharing concept and promote neighbourhood communication. By sharing goods and services, a social network can be established in which individuals can support each other when need arises. Assisting others increases both gratification of those being helped, but also one’s own satisfaction and feeling of self-value. In addition, every single resident supports social justice by giving people with lower incomes access to cash-free or money-saving alternatives, e.g., borrowing and lending.

Focus on residents/ target group

1. Quality of living improvement

The thermal renovation of the building envelope significantly reduces the energy demand of the entire building. On the exterior, apart from fulfilling its role as a physical protection of the building’s core and an architectural feature, the façade will be designed and constructed as an “active” façade, by actively producing, storing, and transferring energy. This activation acts to ‘condition’ the existing building whereby heating and cooling activities take place. In the interiors, temperature flows of the existing radiators can be lowered and the radiators only serve to adjust to user-dependent temperature requirements. In poorly insulated buildings, with outdated heating technology, the ancillary costs lead to a „second rent“ that not all tenants can afford, with tendencies rising. Our façade activation, makes it permanently possible to reduce ancillary costs for the building’s residents. At the neighbourhood level, the integration of active technologies, especially photovoltaics, enables a cost-effective electricity supply. Energy-efficient building refurbishment contributes to energy efficiency and climate protection at the same time.

The integration of community spaces, greenhouses, and roof-top gardens on the upper floors offer the possibility for private and communal activities. Such areas will significantly improve recreation and leisure activity offers, while having a positive effect on the social cohesion of the residents. Furthermore, green roofs offer advantages on an economic, ecological, and social level. The surrounding quality of air is improved, because plants filter fine dust and convert CO2 into oxygen, thus supporting air purification. In addition, greening creates a pleasant and cooler ambient climate, because plants absorb sunlight. Green façades also reduce noise pollution, by providing a kind of sound absorber between residents and the outside urban environment. Green environments, whether they be green façades, roof-top gardens, common lawns or parks, provide relaxation and reduce stress, which in turn improves people‘s common well-being, while promoting biodiversity.

Lifts and balconies will be added to the existing building, and the entire building and all its flats will be redesigned to be barrier-free. This will permit residents to be able to remain in the neighbourhood until they are elderly, even if physical limitations arise. Adding such facilities will increase user comfort, increase the size of required movement areas, while providing more space. Barrier-free living will also give residents a sense of security, as sills, steps and thresholds are removed thus preventing accidents and falls, which will make everyday life easier. This will not only benefit physically-limited residents, but will also increase the quality of living for people without physical limitations. Sustainable construction, with a long service life, is increasingly becoming standard practice. Barrier-free construction can also be sustainable, as flats can be adapted to the needs of the users and long-term usability is thus ensured for all potential residents. The longer a building is occupied, the more economical it is in the overall balance.

The sharing concept also contributes to the quality of life, because the accessibility of the app and the variety of car-sharing options increases living satisfaction. Residents without the necessary financial means can also enjoy the benefits of driving, and the occasional loan of a car or bicycle makes everyday life easier and increases independence. In addition, the conscience is also rewarded, as each individual resident contributes to producing fewer goods and thus saving resources through the shared use of cars, bicycles, goods or services.

2. Room program and interior design

The modular expansion and renovation system “levelup” can deliver additional living space with balanced apartment sizes

to the neighbourhood. Building and installation time can be decidedly reduced with the use of modular-wood construction. Prefabricated modules arrive at the construction site with preinstalled interior fittings and installations even before being positioned on site. The size of the modules depends on the transport dimension, which is 3m x 7.5m. The apartments planned in our additions of storeys consist of 2 or 4 modules. The number of occupants in any given apartment will determine the size and usage. However, due to an increased demand for smaller living spaces, the focus is on compact floor plans. All apartments in the levelup system can be accessed without barriers and the interior design can be adapted to the needs of the residents. There is also the potential for apartments for caregivers to provide assisted living in the neighbourhood. Common spaces are one of the main focal points of the addition of storeys, because they are available to all residents of the building, and provide meeting spaces, studios, quiet areas, and co-working spaces. They can also be additionally rented for commercial, communal or private activities. Furthermore, roof-top terraces, greenhouses, and gardens will be created throughout the addition of storeys and provide spaces for relaxation, urban gardening and leisure activities. Above all, this will promote social interaction between residents and strengthen the sense of community.

3. Scalability

a) Need for upscaling

Increasing land consumption for settlement and transport purposes can be observed in Germany. According to the Federal Statistical Office, this area increased by 11,184 km^2 or 27.7 % from 1992 to 2019. This corresponds to an average increase of 180 ha or almost 2 km^2 per day. The settlement area alone has expanded by 40 %. Based on these figures, it becomes very clear that with this ongoing urbanisation the demand for usable space is growing increasingly. This highlights, even more than ever, why sustainable construction methods that do not build upon undeveloped green areas are becoming essential. Available space is an increasingly important resource. We have taken these decisive factors into account when we designed our modular and adaptable addition of storeys and renovation method = levelup system. This revolutionary system is to be constructed on top of a building in the Ludwigsfeld neighbourhood of Nuremberg. This particular building was chosen for the Design Challenge, because it is representative of the predominant building stock built between the 1950s to the 1970s in Germany. The potential of expanding the levelup system is significant and could possibly contribute to a major reduction in the current housing shortage. Using the addition to storeys methodology could create over 1.1 million housing units on top of existing multi-family buildings from the 1950s - 1980s. Using existing networks would avert the need to zone for new buildings and transport, which would otherwise consume between 10,200 - 24,600 hectares of undeveloped area. Our system can also be adapted to other building typologies and structures due to its modularity, geometry, and adaptability. The range of housing typologies and communal areas can be adapted and matched to the respective urban quartier. In the context of additions of storeys, office and administrative buildings, as well as multi-storey garages can be converted. The primary structure is retained and, if necessary, adapted to the special needs of living, commercial, or specialty functions. The more reduced the primary structure of the existing building is, the more flexible the development of the floor plan can become, and the more economical it will be to convert the building to residential use with a modular construction method. The high degree of prefabrication of the modular-timber construction method also makes low-cost additions possible with decisively reduced construction time, which enables more favourable project financing options compared to conventional renovations. The renewable energy generation of electricity and heating or cooling on a neighbourhood level is also scalable as needed. For many years, the construction of new residential buildings has been the norm. However, if exceedingly more building renovations and refurbishments are realised in the future, additions to storeys or other types of existing building conversions could become the new standard. The basic economic advantage lies in the fact that the existing land or building already possess its infrastructure. The higher the price of real-estate, the greater the economic advantage over new construction. Further potential lies in the fact that the energy concept in the flats should be so well designed that they can be connected to the existing energy system. The success of the energy transition requires not only the use of renewable energy, but also lower energy consumption. In this aspect the building sector has much untapped potential. New buildings already meet the high energy regulations, but existing buildings more than often do not. This is where energy-efficient renovation comes into play, which, in addition to the positive effect on the climate, also has financial advantages and offers modern comfort. Renovation can make energy upgrades faster and cheaper, while maintaining the same high quality. It is not a traditional renovation by craftsmen, but a façade insulation and a solar system that produces enough electricity per year to power the heat pump. Energy-efficient renovation can be a useful complement to conventional renovation approaches. Economically viable renovation solutions must be sought for buildings from the 1950s to 1970s, because from a social standpoint, rents should not continue to increase simply for the fact that buildings are to become climate-neutral.

b) Implementation

Implementation requires that the building, and floor plan typologies thereof, fit to the required levelup apartment configurations. The addition to storeys comprises two and a half building levels, which are designed as private living spaces, communal lounges, and utility spaces that are to be constructed on top of existing buildings.

Generally speaking, the planning of a building project, depending of course on the scale, has an almost endless list of topics to be considered. However, before we present these and the construction process, it is important to address some specific, corresponding topics where overlap can occur in the planning process. For

a fact, all trades involved on the internal design and planning process should coordinate their technical implementation with the others. Doing so ensures that all processes and transitions run seamlessly, and design and planning mistakes can be avoided upfront that will later on affect construction. For instance, when planning the façade and timber construction, it is important to carry out an exact measurement of the existing building fabric. A soil survey should be conducted to ensure that building loads can be transferred without issue, because it may also play a role for the reinforcement of the foundations. Seeing as the flats in the existing building are to remain occupied during the entire construction phase, it is extremely important to plan and schedule the renovation. Proper implementation is crucial to reduce the stress on the residents, and to avoid constant disturbances to their daily lives. Alternative options and dialogue with residents should be sought. In addition, the building should be inspected by fire and life safety experts, structural engineers, etc., and expert recommendations and clearances should be issued. The vast number of overlapping planning tasks foresee that the construction phase is to be divided into step-by-step phases, which will often run simultaneously. In our existing building, the structure is almost identical to the room layout, so the building project can easily be divided into three units, which presents obvious logistical advantages for construction. Different trades can work parallel to one another and, above all, requirements regarding precipitation protection (snow, rain, etc.) and the thermal density of insulation and materials can be quickly ensured in each unit. This process reduces the noise and dust pollution burden on the residents throughout the entire construction phase. An essential part of any major construction or renovation project is the site plan placement and scheduling for a construction crane, which needs to be recalculated and adjusted each time the crane is repositioned. In our case, the placement of the crane is only possible on one side of the building, because it would otherwise obstruct traffic. Attention must also be paid to how the crane's foundation is to be laid out so that the crane can carry the appropriate load.

The Construction Phase

All the activities in the construction phase can be divided into different trades or tasks:

1. Construction site preparation
At the beginning of the construction phase, the general contractor will plan and prepare the building site for construction. This involves providing construction containers, sanitary facilities for the crew, electricity and water connections, and securing the construction site with site fencing, etc. The general contractor is responsible for completely cleaning the construction site and turning over the finished building.

2. Civil engineering
The civil engineers plan and carry out the reinforcement of the foundations. Because planned loads cannot be carried by the current foundations, the building's strip foundations must be reinforced by an injection process or similar. This should be done before the scaffolding is erected to facilitate ease of work.

3. Crane operation
The crane company is responsible for erecting the cranes 1 and 2 according to the building schedule, moving them as needed per construction phase, and dismantling them after construction is completed.

4. Scaffolding
Similar to the crane company, the scaffolding company is responsible for erecting the scaffolding, modifying and reassembling it based on construction needs and scheduling, and dismantling it when the construction is finalized. In our case, the scaffolding will have to be moved once per construction phase, as the addition to storeys extends beyond the façade of the existing building.

5. Demolition
The demolition company is responsible for removing the existing, unheated, hip roof before construction, ensuring that the insulation layer of the top floor remains intact, as well as protecting the exposed upper floor slab against rain or other forms of precipitation/moisture. The used roof tiles are to be crushed and reused as filler for the modular ceilings units in new rooms.

6. Building construction
The structural load of the addition to storeys will be partially carried by the existent load-bearing structure, in our case masonry walls, of the existing building. In order to stabilize these, the masonry walls have to be reinforced with the help of ring anchors so that the shoring which supports the timber modules have a reinforced foundation on which to rest. In addition, the construction company has the task of installing all balconies and the staircase cores, including all lifts (elevators). Demolition and construction work must also be carried out in order to connect to the existing staircases.

7. Carpentry and timber construction
The timber construction company will prefabricate, assemble, and mount the required number of individual room modules per construction phase. They will adhere to air and moisture density and fire protection requirements. The timber construction company is also responsible for assembling the roof structure and its cladding / waterproofing. After completion, finish-carpentry work is scheduled in the erected building shell.

8. Building technical trades, i.e., mechanical and electrical engineering
These trades are responsible for the connection to utilities in the existing building, and the necessary optimisation or replacement of the existing utilities / technology. Mechanical engineering trades cover heating, ventilation, and cooling systems, and their testing, etc. Electrical engineering trades cover electrical installation, connections, dependences, volumes, and testing, etc.. The main distribution for mechanical and electrical systems has been

planned in conjunction with the building trusses. A scheduling buffer has been planned for any residual work that needs to be coordinated with other trades or carried out in later phases of construction.

9. Plumbing / sanitary
Connection and commissioning of the plumbing and sanitary facilities. A scheduling buffer has been planned for any residual work that needs to be coordinated with other trades or carried out in later phases of construction.

10. Drywall construction
Remaining work that cannot be carried out in the prefabrication phase will be completed subsequently by a drywall construction company.

11. Façade construction
The façade installation requires the prefabrication of wall heating systems. Mounting systems are to be attached, on which the prefabricated façade will later be hung and mounted. It has been recommended by experts that the façade of the addition to storeys be installed first, followed by the new façade of the existing building, i.e.: top to bottom, in this order. This protects the lower façade from any falling parts and makes it easier to anchor the scaffolding to the existing building for the 'over-head' construction.

12. Painting
Once the shell of the building has been completed, the painting company can paint all the finished areas, such as the renovated staircases.

13. Interior fittings / finishing
Before the building can be handed over for occupancy, interior fitters will install any built-in or pre-mounted furnishings, appliances, equipment, and devices.

figures

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38 CESA Report

Table of contents

38.1. Communications sub-report

Over the past two years, the team first intensively analyzed the initial situation, derived the vision and positioning of the concept, and then developed and implemented communication actions for various target groups. The key messages were implemented in the website, social media and audio-visual presentation. The communication planning has been further developed and concretized in recent months.

38.2. Analysis

In Germany, three quarters of the population already live in big cities. In the coming decades, this proportion is expected to increase to 85%. Urbanization is one of the megatrends of our time. Especially the younger people (20-40) we expect are moving to the big cities. But the proportion of the population over 65 years of age will also grow to 20% by 2040. This means that the number of single-person households will rise significantly - in 2040 one out of four people will live in a single household. This leads to housing shortages and as a consequence rents have risen by almost 80% from 1990 to 2019. In cities 2.5 million low-income households will have to be provided with housing. (Bloeckler, 2018).

But space is limited! Our main challenge is that 43% of residential buildings in German city centers were built between the 1950s and 1970s. Most of them are in dire need of renovation, because they consume too much energy than they should, 75% of all buildings are classified as energy inefficient.

So, the demand for affordable, attractive, and sustainable urban living space is growing, especially for low-income, young and older single households.

In future, environmentally oriented building renovation and social housing will be strongly promoted by state-run programs. (bayern-labo.de, Federal Ministry for the Environment, 2019) The creation of energy efficient rental housing and attractive concepts is therefore very interesting for housing associations and the construction industry.

The team has intensively dealt with the opportunities and risks in the market for inner-city housing construction, as well as the strengths and weaknesses in Germany.

These aspects are summarized below in a SWOT analysis:

Strengths
- Most economically powerful country in the EU
- High average income and high standard of living
- Good labor market
- High educated and well-trained professionals
- Statutory social assistance

Weaknesses
- High stock of 43% buildings in Ger-man city centers were built be-tween the 1950s and 1970s
- 75% of all buildings are classified as energy inefficient
- Lack of barrier-free housing
- Space for new buildings is limited

Opportunities
- Urbanization as a megatrend
- Especially young people (20-40 years) move to big cities
- Income inequality gap be-tween rich and poor is growing
- Energy turnaround by 2050: goal of a climate-neutral building stock and the supply of renewable energies
- Support for renovation and modernization from government

Threats
- Housing shortage
- Sharp rise in rents. But rent brake is supposed to slow down rent in-creases
- High political requirements for the energy efficiency of buildings
- Demographic change - high proportion of people over 60

Due to our high competence in the field of sustainability and our already gained experience in SDE2010, we are able to develop a demand-oriented concept for the extension / refurbishment of old buildings for young and older residents.

38.3. Strategic planning

As the analysis has shown, there is a great need for adding floors to older buildings. The team at the Technical University of Rosenheim is pursuing the goal of creating additional living space in city centers by modernizing, upgrading and adding storeys to existing buildings from the 70‘s-90‘s.

Modular timber construction creates additional, cost-effective and flexible living space without having to build on greenfield areas, which is so important for the town‘ s landscape. A major feature of modular construction is that living spaces can be flexibly adapted to the individual requirements to different phases of life demand.

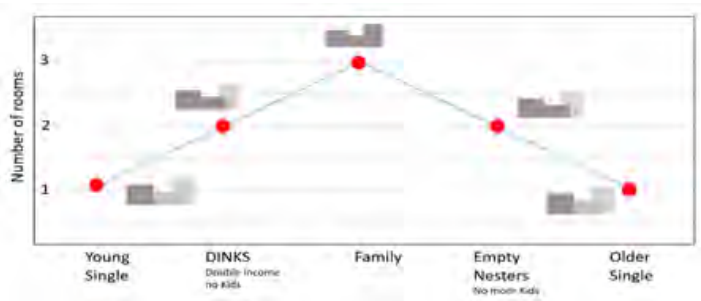


Figure 1 – Concept of modular construction adapted on life cycle:

Our design considers different households with socially disadvantaged backgrounds and integrates them into a common living environment.

a) Communication objectives

Our main communication goals - based on the AIDA formula - are:

AIDA	Objectives of communication
Awareness	• to draw attention to our concept • to build awareness of the social and ecological effects of building measures
Interest	• to arouse interest in the individual characteristics of the concept through providing knowledge about the core idea and the specifics of the technical details, the design and construction and about the possibilities of energy-efficient and low-cost housing • to create a positive image of the Rosenheim design and sympathy for the team
Desire	• to trigger enthusiasm and motivation for energy-efficient building pro-jects • to awaken the interest to visit or sponsor the project or even to live in the apartments • to show the advantages of the concept
Action	• to initiate the visit of SDE Wuppertal • to win construction projects and future customers or users

Depending on the target group, different goals are in the foreground. A detailed analysis of the target group in the next topic makes this more obvious.

b) Target groups and analysis of their needs and requirements

Different target groups of communication were identified to whom our team shall address the project and idea of the concept.

1. Visitors of the SDE area in Wuppertal: for example, pupils (children and youth), students, professionals, experts, and general public.
2. Publicity at the locations Rosenheim and Wuppertal
3. Students and lecturers at the Rosenheim Technical University and other universities
4. Customers in the construction industry, for example owners and investors, architects, project developers, housing associations, building contractors, municipal authorities, building inspection authorities, experts, companies, and suppliers
5. Tenants and buyers (end users) of apartments in city centers. A detailed analysis of the structure and needs of existing residents in older existing buildings can be found in Report
6. Sponsors, for example, service providers or suppliers from the construction industry or other financial sponsors of the university

The target groups differ in terms of their needs, interests and media use and must therefore be ad-dressed differently. The following table lists the needs and usage channels of the target groups.

1. Visitors of the SDE area

a) School classes and families

Needs of Target Group:
- Learn about sustainability in an easy way
- Entertainment and Excitement
- Pleasant leisure activities

Goals of our Communication:
- to draw attention to our concept
- to build interest to the social and ecological topics
- to entertain the visitors and trigger enthusiasm
- to create a positive image of the Rosenheim design and team
- to initiate the visit of Rosenheim project at the SDE Wuppertal

Measures of the Communication:
- Do it yourself activities (build your own home with small 3D printed modules
- Quiz about sustainable living
- Guided tours and workshops (personal and digital)
- Digital simulation of flexible living concepts and animated studies and models.
- Posters
- Events

b) Professionals and Students

Needs of Target Group:
- Inspiration for future living concepts
- Information on innovative technologies in the field of sustainability
- further information about innovations

Goals of our Communication:
- To draw attention to our concept
- To build interest to the social and ecological topics
- To generate viral communication and recommendation
- To create a positive image of the Rosenheim design and team
- To initiate the visit of Rosenheim project at the SDE Wuppertal

Measures of the Communication:
- Guided tours and workshops (personal and digital)
- Digital simulation of flexible living concepts and animated studies and models.
- Posters
- Events

2. Publicity at the location Rosenheim

Needs of Target Group:
- Inspiration for future living concepts
- Information on innovative technologies in the field of sustainability
- Information about the Rosenheim team

Goals of our Communication:
- to draw attention to our concept
- to provide knowledge about the core idea and the specifics of the concept
- to create a positive image of the Rosenheim design
- to initiate the visit of Rosenheim project at the SDE Wuppertal

Measures of the Communication:
- Public Relations
- Social Media
- Website
- Guided tours and workshops

3. Students

- Inspiration for future living concepts
- Identification with their work
- Get to know sustainable ways of living

Goals of our Communication:
- Generate enthusiasm among students
- To draw attention to our concept
- Spread our idea of sustainable living

Measures of the Communication:
- Social Media
- Posters
- Events at the location Rosenheim
- Tours thru our HDU

4. Sponsors

Needs of Target Group:
- Positioning as an innovative company compared to the competition
- Get in contact with market partners / customers via the university network
- Joint development and market testing of innovations
- Implementation and publicity of innovative construction projects
- Access to professors and motivated students

Goals of our Communication:
- to draw attention to our concept and team
- to arouse interest in the characteristics of the concept and the individual specifics
- to create a positive image of the concept and the team
- to convince of the advantages of the concept and team
- to win new sponsors and get as much material and personal support as possible

Measures of the Communication:
- Brochures and website content for sponsors
- Integration of company logo online and offline channels
- Joint articles and presentations at trade fairs

Descriptive sponsorship Manual (see appendix)

5. Customers in the construction industry

Needs of Target Group:
- Innovative solutions for additional living space
- Cost-effective and fast implementation of construction projects

- Positioning as an innovative company

Goals of our Communication:
- to draw attention to our concept
- to build awareness of the social and ecological effects of building measures
- to arouse interest in the individual characteristics of the concept
- to convince of the advantages of the concept
- to win customers for construction projects

Measures of the Communication:
- professional article
- Fairs / Exhibitions
- Lectures
- Visits to building projects

6. Tenants and buyers

Needs of Target Group:
- Modern and comfortable living
- Feel good
- Affordable living space that adapts to changing phases of life
- Saving energy

Goals of our Communication:
- to draw attention to our concept
- to build knowledge of the ecological effects
- to arouse interest in the characteristics of the concept
- to convince of the advantages and trigger enthusiasm for the concept
- to awaken the desire to live in the apartments

Measures of the Communication:
- Website
- Events
- Brochures
- Visits
- Social Media

c) Messages: Vision and positioning our communication

Our Vision is:

To create sustainable, climate-neutral and affordable housing that adapts to different building types and sizes, as well as to the individual lifestyles and needs of different population groups (social diversity) through flexible use of standardized modular construction.

Allow the details of interior design and technology to enhance daily lives and the environment!

Add storeys on top of buildings so that undeveloped land can remain "green".

Improve the energy efficiency of entire buildings and enhance German city centres architecturally, aesthetically, and socially.

Our vision and core message of communication is:
levelup … your living!

Our communication strategy also includes these additional focal points:

1. levelup … your building

Cost-effective addition of stories using prefabricated, standardized, wood construction elements with attractive architecture. The innovative und barrier-free interior offers many conveniences and high functionality.

2. levelup … your sustainability

Within the framework of holistic planning, the individual planning components that address sustain-ability are interlinked. Natural resources and ecosystems must be protected, and the health and well-being of animals, humans, flora and fauna must be improved.

3. levelup … your comfort

For the provision of indoor comfort, climatic conditions and functionality are vital to increase the personal well-being of the residents and their user satisfaction.

4. levelup … your technology

The challenge is to find the most efficient energy concept in order to realize a carbon neutral building with a low level of energy demand. This will be realized by the use of photovoltaic and solar thermal systems, intelligent building automation and other innovative systems.

5. levelup … your community

Residents in different phases of life live together and form a community that supports each other by sharing services and goods. Green community areas on the roof and sharing concepts strengthen the feeling between neighbors.

A logo and corporate design were developed for this positioning and implemented in all communication media.

Depending on the target group, different messages are given priority. The contents of „levelup ...your community“ and „...your comfort“ are particularly relevant for communication with visitors of the SDE and users or residents of the flats. Information on „levelup ... your technology“, „ ... your sustainability“ and „...your building“ are more relevant for the target groups Universities, Sponsors and Customers in the construction industry. The tonality of the communication is also different - depending on the target group, it is either informative (specialist audience) or entertaining (especially visitors, the public and students).

d) Online Strategy:

The communications team has developed and implemented an online strategy with a website and a detailed social media strategy over the last few months. Target groups are primarily the public, sponsors and the students and lecturers of the TH Rosenheim. The goals are to provide information about the basic concept and the work in the individual teams as well as to create sympathy and enthusiasm for the concept.

The website can be found under the following URL:
https://levelup.nicepage.io/Home.html

Social media channels are used to generate interest, provide information and insights into the over-all project and trigger sympathy for the team. With the help of an editorial plan, the team has structured and planned the content to be shared for each channel. The following channels were selected to expand the social media presence:

LinkedIn: www.linkedin.com/company/levelup-rosenheim
Facebook: https://www.facebook.com/leveluprosenheim/
Instagram: https://www.instagram.com/levelup_ro/

38.4. Operative planning

The communications team has developed and implemented an online strategy with a website and a detailed social media strategy over the last few months. These measures have always been strictly adapted with our Corporate Identity. (See Appendix)

Target groups are primarily the public, sponsors and the students and lecturers of the TH Rosenheim. The goals are to provide information about the basic concept and the work in the individual teams as well as to create sympathy and enthusiasm for the concept.

In addition, experts, sponsors, and the construction industry were addressed via numerous presentations, technical articles, a regular newsletter and visits to trade fairs. The public in Rosenheim and Bavaria was reached via events and reports in the regional press. Visitors in Wuppertal are addressed via multimedia information. These measures can be found in the Social Awareness section.

All measures are presented below:

Measures of the Communication	Visitors SDE Wuppertal	Publicity Rosenheim	Publicity Wuppertal	Students Universities	Sponsors	Customers Industry	Tenants / Buyers
Online Measures							
Website	X	X	X	X	X	X	X
Social Media (facebook, Instagram, Linkedin)	X	X	X	X	X	X	
Video Concept Level up							
Newsletter					X	X	
Digital simulation of flexible living concepts	X			X	X	X	X
Offline Measures							
Public Relations (Press, Radio, TV)		X	X				
Brochures					X		X
Professional article		X			X	X	
Events	X	X		X			X
Fairs / Exhibitions				X	X	X	X
Lectures		X				X	
Posters	X						
Visits to building projects		X		X		X	X
Integration of company logo					X		
Guided tours and workshops	X	X	X	X			

Also see appendix – Table 1

a) Website

The website is intended to present basic information and news about our project to all target groups and will be updated regularly.

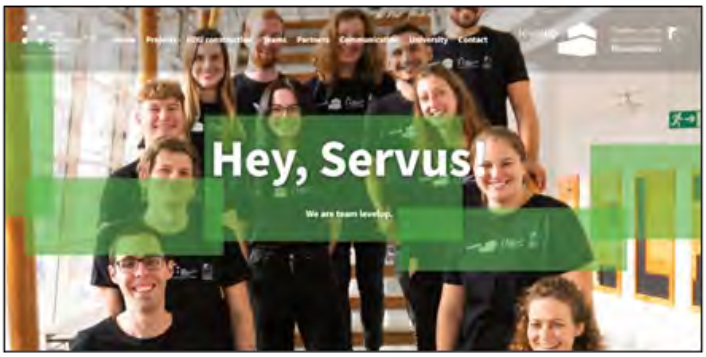


Figure 1 – Website levelup

The homepage consists of a total of seven components:

1. In „Home“, after a short introduction, our vision is clarified, and our visitors will get a first impression of the concept with an image of our HDU.

1. Since January 2022 we have integrated a pop up window on our homepage, which leads the visitors to our subpage ‚HDU Construction“. On the subpage our HDU is presented first and in the further course a gallery to our construction site diary is presented.

2. Projects“ shows impressions and information about the project from Rosenheim from the SDE 2010 in Madrid and our progress to the current competition.

3. In the section „teams“ our team leaders are introduced with the respective area of responsibility, possible job offers are shown and all other team members are presented.

4. In „Partners“ our sponsors with their logos find a place. In addition, the advantages that can be achieved through a partnership are listed here.

5. Communication“ contains the current press kit, our remaining social media channels, our interview „meet the teams“ and a small picture gallery.

6. In „University“ you will find a short description of our university also with a picture gallery.

7. Contact“ offers the contact information of our main contact persons and a map of the TH Rosenheim.

b) Social Media

Our social media channels are intended to inform various target groups about current topics, generate interest and provide insights into the overall project. In addition, the aim is to create awareness of the social and ecological impact of construction measures and to generate enthusiasm and motivation for energy-efficient construction projects.

Accordingly, we have aligned our social media concept on Instagram, Facebook and LinkedIn:

• Instagram:
On Instagram, the content is a combination of official pictures and insights into the daily project life of the team members. Since Instagram is a very visual platform, the texts are deliberately kept very short.

Figure 2 – Instagram Profile levelup

• LinkedIn
We use LinkedIn primarily to reach out to our existing sponsors and partners, but also to make the construction industry aware of our project. The posted content includes especially events or reports, but also models and progress of our project.

Figure 3 – LinkedIn Profile levelup

• Facebook
The content shared on Facebook is a mix of Instagram and LinkedIn. We work with more factual and detailed texts to reach not only students with our posts, but also our sponsors, the construction industry, and future tenants and buyers of the apartments.

Figure 4 – Facebook Profile levelup

c) Video/Youtube Channel

For the distribution of our image films, which present our vision, our building project, and our team, we have decided to create our own YouTube channel.

With our image video we want to convince new sponsors but also our current partners, the students, and lecturers as well as the public of our project.

The video consists of three parts, at the beginning and at the end our team members are introduced.

In the main part you can see an animation that explains our vision and our concept and a drone video, which should illustrate our idea of the life cycle model emotionally.

d) Newsletter:

With our newsletter we want to address our partners and sponsors.

From now on, these target groups will be regularly informed about our project progress and work results. Our newsletter will refer to the main milestones in our interdisciplinary teamwork.

The structure will be based on the different disciplines of the competition, introducing our team‘s visions, and briefly presenting work results and outlooks.

The first newsletter referred to our updated image film, our location at the competition site in Wuppertal, and the introduction of our current team members.

Each newsletter also refers to our website and our social media channels such as Instagram, Face-book, LinkedIn and YouTube. The plan is that in the future anyone can sign up for the newsletter via our website.

e) Podcast:

So far, we were allowed to participate in two individual podcasts as invited guests.

In the first audio podcast, we were able to present our project participation in SDE21 on RO-LIP Ra-dio at TH Rosenheim in general. This was a live recording, which can also be listened to on Spotify afterwards.

In the second podcast we got the opportunity to accompany the kick-off event of the podcast series ‚Talent Talk‘ of the Holzbaunetzwerk Deutschland. There we were able to present our innovative levelup guiding ideas in architecture and construction.

f) Public Relations

(Press, Radio, TV): In total we have published four articles (14th June 2020, 30th September 2020, 3rd March 2021, 28th January 2021) in the regional newspaper (Oberbayerisches Volksblatt) for the city and district of Rosenheim, and a few more articles are planned for the competition final. About 40.000 copies were sold per article, with each copy being read by an average of 3.51 readers. As a result, we have achieved a very large regional audience and attention, which has been reflected in several e-mail enquiries. In addition, several spin-offs have published articles about our participation in the SDE 21/22, including the Rosenheim Journal or the Samerberger Nachrichten with a reach as far as the Austrian region. Also, we participated in a podcast (27th of May 2021) of the Technical University of Applied Sciences Rosenheim. There we were able to communicate our project to the entire university family (potential audience of 6.383 students and 568 employees) in a 1-hour live interview. The recordings are now available to the public on Spotify. Through this event, we experienced a very high interest within the university. We were also invited by the German Timber Construction Network to a podcast (4th June 2021) for the “Young Talents” kick-off event. The one-hour recording is published nationwide and promoted on the organiser’s social media. Shortly before the event in Wuppertal, we will again be invited to a podcast in this forum. By doing so, we hope to attract national attention and interest in our project, as well as new contacts to partner and sponsors from the timber construction business. In September 2021, we gave a keynote speech about our participation in the Solar Decathlon Europe 21/22 at the Forum Neue Energiewelt in Berlin, the leading conference for renewable energies, and presented our visions, ideas and competition entry. Under the topic visionary science, we have given the final lecture

in front of several hundred people and gained very high interest. In addition, our partners have published several articles (Vela Solaris, ALPI_Software, Sparkassen-Stfitung, Energie-Zukunft Rosenheim, Staatsministerium für Wohnen, Bau und Verkehr) about our participation, where we hope to reach an international audience (further Information at CESA-Implementation List). Moreover, we show the intensive and close cooperation in the competition with our partners and hope to gain new sponsors from research and industry. Through our communication measures, we were able to attract more than 70 partners and sponsors. Television accompanied us during the construction of the HDU and the topping-out ceremony. The RFO (Regional Fernsehen Oberbayern) has broadcast a report on TV about this. We are currently working in close cooperation with the Bayerischer Rundfunk on a TV-report entitled „Building without concrete“, in which our project will be presented. The film will be shown on TV in May 2022.

g) Brochures:

For environmental reasons, we keep print media relatively low. However, in summer 2020 we distributed a sponsor flyer (approx. 300 copies) at the university and potential companies to promote sponsor acquisition. We also distributed a total of 400 Press Kits to partners from industry and research in 2021. However, digital media are sent out as a preference.

h) Professional articles:

In the journal “Sonnenenergie” the levelup team initiated a series of articles for all German teams participating in the competition. The main aim is to present the teams and their visions and to publicize the Solar Decathlon. Together with the other German teams, further joint article series will be published in other journals (architecture, timber construction, building physics, energy technology, …) in the future in order to reach a wide range of specialists audiences. Innovative, sustainable and transferable ideas and solutions will be presented. The aim is to appear in public together as “Team Germany”. In the besides, several articles have already appeared in trade journals such as Bauphysik, Campushunter and Haus & Grund Wuppertal. We are especially proud that the very renowned Detail-Verlag has reported about our project! Currently we are planning a scientific book about the participation of the seven German teams in the competition. The book is open access and will be published in autumn 2022. Also the organizers are planning a book and a booklet about the participation of all 18 teams in the competition.

i) Events:

We participated in the digital conference “PV-Symposium”. The conference took place from 18th – 21st May and on 25th/26th May 2021. The levelup team published their results (CO2-neutrality and plus energy through renovation and addition of storeys in urban areas: concepts for Solar Decathlon Europe 2021/22) at the conference in form of a scientific poster and an article in the conference proceedings. In addition, our poster was presented to the audience during a live poster-session (about 350 participants).

On 22nd and 23rd September 2021 we gave a keynote speech on visionary science to an audience of several hundred participants at the Forum Neue Energiewelt in Berlin / Germany. We also had an exhibitor booth at this conference and represent our levelup team and concept.

In the meantime, we were co-organizers at the 3rd Rosenheim Climate Spring and the 29th annual conference of the Bavarian Solar Initiative Working Group (Arbeitsgemeinschaft Bayerischer Solarinitativen, ABSI) with over 750 participants. There we led a presentation session on building integrated photovoltaics and the Solar Decathlon-competition, were we also presented our competition entry.

In January, the modules were manufactured and delivered to the construction site at the university. On January 23, a large topping-out ceremony was held with 150 participants from the university (students and faculty), the city of Rosenheim, Sponsors and Bavarian politics. Several reports appeared in the local press on the event, the positioning of the building and the topic of sustainable construction.

j) Fairs/Exhibitions:

Due to the Corona pandemic, it has not been possible to participate in a fair so far. Future participations will be planned. After the end of the competition final, the architectural models and competition results shall be presented in fairs and exhibitions.

k) Lectures:

Several lectures have already been held to inform the sponsors about the project development. In addition, presentations were held in front of students to find new team members. As part of last year's in-formation day at the university, the Solar Decathlon was also presented to school groups in form of online lectures. Within the topping-out ceremony of our House Demonstration Unit we held a lecture in front of politicians, press and sponsors.

l) Posters:

We published a scientific poster at the PV-Symposium in 2020. No further conferences were held due to the Corona pandemic. However, after the competition finals, the results will be presented in the form of posters at various conferences and symposiums. In addition, some team posters were spread on the campus of the TUAS Rosenheim to raise awareness.

m) Visits to building project:

The interior design course and engineering students took a closer look at the HDU from our entry in the Solar Decathlon Europe 2010, which is currently being used as a hotel room by the B&O Group in Bad Aibling. The aim was to get an impression of the quality, quantity and function of the HDU. The information will be used as a basis for further interior planning. Further visits with other student groups and school classes are planned.
The new House Demonstration Unit will be set up on the campus of the university in Rosenheim after the end of the competition. The rooms will be used by the family office there. In addition, the HDU will be used for teaching in the construction-related courses of study, as well as being accessible for further research.

n) Guided tours and workshops:

The construction site is protected by a large pavilion. Since the big topping-out ceremony event, this has housed an exhibition with posters and material demonstrations for all interested visitors. In addition, on the scaffolding of the pavilion large posters with a QR code is attached, through which one can access the website with all the information.

After completion of the building in April, guided tours for school classes and public lectures on the topic of sustainable construction are planned.

38.5. Implementation, Assessment / Controlling

The following table shows how often our activities were used over time:

Also see appendix – Table 2

The implementation success of the measures is regularly monitored.

a) Website:

Google Analytics has been used to analyze the website since 05 June 2021. Since that time, the following statistics have developed.

Due to a programming error, no new reports came from Google Analytics in the period from January 2021 to December 2022. Since January 2022, our website has been analyzed by Google Analytics again.

In total, there were about 2.873 page views during a period of one year, with „Home" with 846, „HDU Construction" with 307 and „Teams" with 240 clicks representing the pages with the most interactions.

Our goal is to further increase the interactions. This will be generated via increased use of newsletters and social media activities.
The analysis of users by origin shows that our website has been visited from people from all over the world: Germany, United States, Austria, Finland, France and Italy.

b) Social-Media:

We have created a rough editorial plan for all our social media channels based on the milestones. This should help us to focus on the facts of our project and the competition from now on. We want to explain to our subscribers as clearly and simply as possible the connection between the Design Challenge and the Building Challenge. But also the background, e.g. to our existing building or to our vision should be clearly communicated.

The insights of the respective platform were used to evaluate the social media profiles. These provide information on the development of subscribers, reach and impressions for a limited

period of 30 days. In order to obtain an overall picture of the development, monthly excerpts of the insights were generated.

• Instagram
Compared to last time, we gained 100 new subscribers. Currently, 539 profiles follow us on Instagram. In the last 90 days we reach an average of 4.135 accounts through posts. Stories have a reach of 654 accounts. Our posts generate around 7.619 impressions. This means that we were able to achieve an increase of 26,7% compared to last time as well.

In December 2021 we implemented a ‚cut' on our profile. This also includes that since then only facts about our project and our construction progress are displayed in the feed. Current happenings like events, newspaper articles or similar will be published in the stories. The goal is that visitors who visit our Instagram page should immediately recognize what we are working on. They should be able to see images of our renderings or our existing building and clearly understand the context of the design and building challenge.

• LinkedIn
Compared to last time, we gained 122 new subscribers. Currently, 306 profiles follow us on LinkedIn. Our posts generate an average of around 3.288 impressions in a period of 30 days.

• Facebook
The Facebook page has 96 likes and 104 subscribers
We already published 113 posts on our page. As described in the Instagram section, we also made a similar „cut" on Facebook.

c) Newsletter:

Since June 2021 we already send out five Newsletters. We are planning on sending one Newsletter each month.
So far, we have 83 Sponsors and partners in our e-mail distribution list. In average 50% of recipients have opened our newsletter at least once so far, with an average of 7 clicks per recipient. We have linked in our newsletter: our website, the website of our university, our current image film and our social-media channels. Our website and our current image film have been accessed most frequently.

d) Press:

You can find all our Press publications in appendix Table 3.

e) Events:

You can find all events we participated in appendix Table 4.

38.6. Education Sub-Report

a) Education Analysis

Together with students, professors and staff, TH Rosenheim have developed a set of guiding principles designed to strengthen our members' community spirit, sense of identification with the university and readiness to take on responsibility. The SDE and its innovations blend perfectly into the guiding principles.

1. Educational principle: We base our teaching on science and business

We offer our students forward-looking practical training with a focus on society and the world of work. TH Rosenheim has excellently equipped workshops and laboratories, which are intensively used for teaching and research. The construction of prototypes and „research-oriented teaching", are integrated into our curriculums wherever possible. Projects are regularly carried out with and for external clients/partners, but always with a focus on freedom of teaching and research. The SDE takes students from their desks into the physical world of human interactions and construction, solving real world problems and therefore fits perfectly into the TH Rosenheim educational principles.

2. Future: Innovation drives the future, inspiring our action

Quality in teaching and research is our highest priority. We are keen to experiment and dare to be imaginative. With creativity and risk appetite we offer an environment in which good ideas are quickly put into practice. We make use of the diversity of our degree program in an interdisciplinary manner.

The range of innovative program offered at TH Rosenheim continuously expand, including "Applied Psychology" or "Energy & Building Technology" and may more. Therefore, TH Rosenheim has the necessary specialist areas to successfully carry out topics of urban transformation addressed in the SDE or comparable competitions.

To ensure quality in teaching and research TH Rosenheim maintains close cooperation with the regional economy and research institutions – at the SDE for example with the Rosenheim

Institute for Window Technology (ift), German Sustainable Building Council (DGNB) and Bavarian politics, in order to be on the cutting edge of research and to assure the practical and social relevance. Furthermore, three of the five main interdisciplinary research areas of TH Rosenheim ideally suit to the SDE topics:

- „Bioeconomy, Wood Technology and Bio-based Materials": A focus is set on circular bioeconomy with the topics of chemical wood technology, recycling technologies and the entirety of the wood cascade.
- "Health, Social Change and Well-being", investigates different aspects of our hu-man being. A focus is set on measures of preservation and rehabilitation of health (including barrier-free building) and for a mental well-being, particularly, for a transforming society.
- "Building Construction, Planning and Energy" investigates different aspects of the key topic building construction; from planning, implementation, and energy supply, up to living (e.g. age-appropriate). With a focus always set on sustainability.
- Ideas generated within the SDE will be used by other research projects and might lead to further third party funded research.

3. communication: we talk to each other

Communication between ourselves and with the outside world is characterized by transparency and openness, participation and cooperation. These are principles that all members of our university are obliged to follow. Our university serves regional development through its implementation of re-search and development, knowledge and technology transfer.

Communication is an important part in the SDE and comparable competition. The chances for TH Rosenheim, especially the gain in know-how and positive advertising for students, teachers and ex-ternal partners are estimated to be very high. The SDE 2021/22 offers the ideal chance to get attention far beyond the region, therefore newspaper articles and TV reports are planned throughout the SDE. Furthermore when solving SDE topics we follow a participatory research approach and hence intensify commination, e.g. with surveys and workshops with Siedlungswerk Nürnberg and their residents.

4. A learning university: We improve through learning

Each of us strives to learn continuously and we pass our knowledge and our experience on to others. We want to recognize new opportunities more quickly and focus our solutions, organization and actions accordingly. We want to create a regional knowledge network in which everyone gives and takes. Our goal is bringing together the right partners from private and public sector and facilitating synergies for technological and social progress.

The SDE offers an abundance of possibilities for knowledge creation and transfer. Project partners offer trainings, not only to our students (e.g. DGNB training) but to all partners included in our SDE network. Furthermore all TH Rosenheim students should have the opportunity to deal with the topics of the Urban Solar Decathlon from their bachelor studies to their doctorate.

5. Society: We have a social responsibility

We help to improve education and training through our knowledge and solutions. We are committed to the responsible use of natural resources. Gaining a qualification based on knowledge safeguards the future of our staff and our students.

We believe that all students should think about the social and ecological impact of their work as well as reflect on society and politics. The SDE provides students and professors a space to discuss the big questions about future living, ask questions every student should ask about a life/a world worth living (in) and make experiences that everybody should experience firsthand.

The following table shows a SWOT analysis regarding SDE teaching.

SWOT analysis regarding SDE teaching:

Strengths:

- Variety of study program with a focus on SDE topics
- well-developed educational concepts
- professors with good business contacts
- high number of students with vocational educational training back-grounds / practical experience
- part time program: students from the field bring their experience to TH Rosenheim and put their newly acquired know-how back into practice
- different knowledge transfer formats

Weaknesses:

- 3 different campus´ with apx. 70km distance
- Space shortage within the university (laboratories, project office, construction space)
- Covid restriction in (distance / hybrid learning instead of hands-on social learning)
- State funded basic equipment
- professors with high teaching load (18 SWS)

Opportunities:

- positive advertising for students, teachers and external partners through the SDE
- Interdisciplinary cooperation throughout faculties
- digital transformation in hybrid and flexible learning (HyFlex)
- new learning formats, e.g. practical semester at SDE
- new study programs planned

- enriching of teaching through hands on SDE topics

Threats:
- Restricted physical interaction due to covid
- Third party funding needed
- Space needed
- High management expense due to many different seminars / study program

b) strategic planning on different levels & operative planning

1. study program (B.A., M.A., PHD)

TH Rosenheim has the necessary specialist areas to successfully carry out SDE related topics. Our goal is to offer a variety of students the possibility to participate and grow with the SDE. As seen be-low a fast number of students are reached through SDE related lectures and actively participate as a team member in the SDE contest.

The number of final thesis (BA / MA) as well as practical semesters shall be gradually increased.
SDE related education

study programmes, B.A.	SDE Team members	specific SDE lectures	thesis	practical semester	FWPM open to all students
Business Studies					
Business Administration	x	x		x	
Business Mathematics – Actuarial Sciences					
Technology Studies					
Chemical Engineering					
Chemtronics					
Electrical Engineering and Information Technology					
Energy and Building Technology	x	x	x		
Wood Building and Construction	x	x			
Wood Technology	x		x		
Computer Science	x	x	x		
Interior Engineering	x	x			
Plastics Engineering					
Mechatronics					x
Mechanical Engineering / Production Engineering					
Management and Engineering					
Environmental Technology					
Business Information Systems	x				
Design Studies					
Interior Architecture	x	x	x		
Healthcare Studies					
Healthcare Management					
Education of Children and Young People	x				
Physiotherapy					
Nursing					
Social Work					
Applied Psychology					

study programmes, M.A.	SDE Team members	specific SDE lectures	thesis	practical semester	FWPM open to all students
Business Studies					
Management and Internationalisation of SMB					
Management and Leadership					
Technology Studies					x
Applied Research and Development	x		x		
Engineering Sciences					
Windows and Facades		x			
Wood Technology					
Wood Construction and Energy Efficiency					

2. PhD

In Germany Universities of Applied Sciences are not generally allowed to grant doctoral titles. How-ever, Th Rosenheim supports the initiation and execution of PhD projects in cooperation with national and international universities. Right now appx. 30 PhD students work at their PhD project at TH Rosenheim, many council the SDE student team as part of the advisory board. It is planned that ide-as generated within the SDE project will lead to further research projects and will be used to initiate new PhD projects.

3. companies & authorities

To ensure a solid funding of the SDE as well as a profound knowledge transfer, a SDE partner network was founded.

Partners in the network support the team levelup through the provision of material or cash resources. Furthermore, as we stated above, we understand us as a learning university. Therefore we are in close contact with the network to exchange knowledge and provide students as well as professionals in the region the best learning environment possible. Excursion and lectures with or from partners give students an excellent insight into everyday business life. Lectures by the levelup team pursue an important educational mission: spreading innovation and initiating an dialogue about sustainable building with politicians and professionals. On a scientific level, publications and congress participations have been carried out. Some recent events:

- the levelup team held the topping-out-ceremony with Bavarian State Minister Kerstin Schreyer and local authorities, Jan 22
- Talk about solar architecture and levelup topics at ABSI Rosenheim (annual meeting of the working community of Bavarian solar initiatives), Feb 22
- Level up participation at Rosenheimer Klimafrühling, Feb 22
- publication “Haus und Grund” with an article about the levelup team, March 22
- 6th International Conference Building Physics & Building Technology / Forum Holzbau. Talk about Building technology in the context of sustainable construction Prof. Stopper April 22

A symbolic turn of the sod was planned for December 2021 on the newly prepared levelup building site with appx 100 participants from business, politics and civil society. Due to the tense covid situation in Rosenheim, the event had to be postponed.

c) Educational concept

Problem-based exercises encourage learning and personal growth beyond classrooms: problems need to be solves as they are encountered and new means of creation are examined. We believe that learning is most effective when knowledge is acquired independently through one´s own actions and tested in experiments. Furthermore, it is a socially facilitated development process in which individuals collaborate and continually redefine knowledge structures and co-create new representations. From this perspective, learning is the result of social interactions.
This perception includes a paradigm shift from traditional lecture-based learning to a self-directed, socially empowered acquisition of knowledge.

Our goal is to design: stimulating learning environments, learning through situation-typical key situation, change from instruction to self-directed learning as well as learning through interpersonal interaction, sharing a common learning experience.

Two exemplary SDE lectures will be presented on two different levels:

Name of lecture: Lighting units

Semester of study / level	Duration	Ideal Number of participants
B.A. 3. semester	1 session: 90 minutes	Up to 12

Teaching content	Relationship between different lighting units. Specifically: Experimental derivation of the square distance law as the basis for the point calculation method. Exemplary application of the point calculation method. Prerequisite: knowledge of luminous flux, luminous intensity and illuminance.
Structure / minutes	1) Teams with 3 students measure the illuminance in black tubes of different lengths and evaluate the measurement results. The teams report their findings to each other. 2) Every student searches the internet for the light distribution curve for an office luminaire. 3) They uses this to calculate the illuminance vertically under the luminaire at a given distance.
Intended learning outcome	After successfully participating in the 90 minutes session students are able… Professional competence: to derive a relationship determined by measurements and apply it to an example.

Lecture two is presented on a semester level, containing appx. 13 sessions over the semester.

Name of lecture: Project Thesis Energy and Building Technology

Semester of study / level	Duration	Ideal Number of participants
B.A. 6. semester	150h / 1 semester	Teams of 3-5

Teaching content	• Project management in practice • Broad field of tasks related to energy technology, building services, and Integral planning depending on the chosen project
Structure / minutes	The students apply in teamwork previously acquired knowledge from energy supply, energy applications or building services engineering on exemplary projects or an integral planning using a residential or non-residential building. • Starting phase Orientation and finding of the subject (e.g. rope pulling against solar power), definition of project goal and requirements: project statement and structure, distribution of tasks and roles within the team with focus on strengths of the team members, development of project structure plan and Gantt Diagram • Execution phase Project management, team communication, project steering and controlling, • Finalization phase Project documentation and presentation, project review
Intended learning outcome	After successfully participating students are able… Professional competence: The theory of project management is understood and is tested in the concrete project work example. Social competence: to apply project management skills such as teamwork, communication and presentation techniques. Self-competence: to evaluate the value of team work (larger pool of strengths in teams and assign tasks accordingly). The students analyze which team roles are suitable for them and which are not. Method expertise: Tools and procedures for project management are tried out and critically evaluated.

38.7. Social Awareness Sub-Report

Based on the communication analyses and SWOT Analysis (Appendix Table 3), the following goals were formulated:
To draw attention to our concept and to build awareness of the social and ecological effects of building measures.

Three basic groups can be distinguished here:

1. Specialist audience with knowledge in technical and building topics and high interest in innovations. This includes lecturers, students and employees in the construction industry from the fields of construction, architecture, energy and environment.

2. Private visitors who tend to have little technical knowledge but sometimes a high interest in environmental topics. These include school classes, families, private visitors.

3. Potential tenants and buyers of real estate.

In 2020 the levelup team has conducted a survey of 160 residents at the project location in Nuremberg. The aim was to determine the socio-demographic structure and value orientations or lifestyle. The results of the survey are presented in the report Urban Situations in the Chapter 2.5 Social structure

The result of the analysis shows that the respondents are in a lower to middle social stratum (in terms of education and occupation), including many pensioners and employees. Most of them live alone or in pairs. Most of the residents surveyed have a more traditional lifestyle.

This is reflected in the fact that 54% would prefer to stay where they are, even if their life situation changes, and for 46% contacts with residents in the neighborhood are very important. Nevertheless, 45% of those questioned are very keen to live in an environmentally friendly and energy-saving way. The result of the survey confirms the suitability of our concept for the needs of residents in old inner-city buildings.

But the analysis also shows potential for social problems.

Two scenarios could be considered here:

1. The modernization of buildings can cost a significant amount of money, which must be borne by the owner Penthouses are offered at higher rents and the additional income is used to finance the energy-efficient renovation of existing dwellings. However, this could create the problem of a social gradient in residential buildings.

2. Cheap and attractive housing is offered to tenants with lower incomes, such as students, single parents, or pensioners. Energy-efficient refurbishment of existing buildings, including energy- efficient extensions, offers the possibility of reducing costs through subsidy measures and by reducing ancillary costs. Here, it would also have to be ensured that all residents use the common areas on the roof in order to avoid social problems. The result is a socially integrative mix of different age groups that support each other.

a) Strategic planning

It must be clear to the public and students that climate policy goals can only be achieved if today's older building stock in the city centers is converted to a nearly climate-neutral condition through energy-efficient renovation. In addition, there is a high demand for housing among low-income, small households with both younger and older residents. However, it is precisely high-income groups that are interested in new, high-quality, and environmentally friendly penthouses.

Our goals can be achieved primarily through guided tours and demonstrations at the Wuppertal site and at the university site in Rosenheim. In addition to general digital communication, we use the sites to trigger attention by the construction site or our building. We inform the public and get them excited about sustainable construction.

The needs of the target groups are different and require different messages. Also the tonality is either informative (specialist audience) or entertaining (especially private visitors, the public, school classes, families and students).

b) Measures and operative Planning

The following measures can be considered to promote social awareness at the relevant locations in Wuppertal, Rosenheim and Germany:

Location Wuppertal SDE campus

1. Students and professionals of the construction industries:

- Personalized tours with detailed information
- Detailed information via QR codes
- Components to touch and try out
- Prototypes, to show the structure of our energy efficient wall or innovative facade
- Showroom for the technical system of the HDU
- Detailed information about the construction und energy efficiency with the help of augmented reality

2. Public and private visitors, school classes and families:

- Entertaining and inter active tours: integration of videos and quizzes via QR codes (See Public Tour Appendix)
- Storytelling - stories about different ways of life, presentation of concrete examples of different living types.
- Visualization of our project with the help of augmented reality.
- Handing out sustainable goodies, such as wooden nails, wooden elements or plants.
- Creating a comfortable atmosphere by adding personal details in our interior design, such as tableware, pillows, pictures, plants.
- Trigger attention with creative signs or flags outside the building.
- Daily changing events, lectures and interactive activities for the public with a focus on sustainability and energy-efficient construction Special guides tours for school classes and young visitors with entertaining and information elements, e.g. quizzes, films, building blocks
- Childcare at HDU with fun games and crafts, so parents can rest easy on our guided tour of the building.

Location Rosenheim

1. Students and professionals of the construction industries

- Integration into the education at TH Rosenheim - projects and research work of different faculties, also long-term development, and follow-up of environmental and social compatibility.
- Publication of reports and articles in the local press.
- Exhibition with informative posters
- Construction components to touch and try out
- Personal Tours with detailed information about the construction und energy efficiency
- 360° guided tour and time lapse video
- Events with official topping out ceremony and get together
- Announcement of the project in the city of Rosenheim through posters and flyers
- Constant press work to spread our idea of sustainable living and the concept of the SDE
- Social-Media, to document the construction progress of our HDU

2. Public and private visitors and school classes:

- Trigger attention at the construction site with construction fence posters, signs or flags
- Guided tours for school classes
- Development and testing of entertaining informations e.g. quizzes, films, building blocks
- Personal storytelling - stories about different ways of life, presentation of concrete examples of different living types.
- Lectures, events and interactive activities for the public with a focus on sustainability and energy-efficient construction
- Articles in the regional press

Germany-wide communication

- Publication of reports and articles in the press with the aim of publicizing innovative ideas for increasing efficiency and renewable energies in older buildings.
- Digital communication and animation of flexibly applicable models via Internet media: Website and Socialmedia.
- Presentations at trade fairs and conferences on technological competence and highly efficient and renewable technologies.

CESA IMPLEMENTATION LIST

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

Communication

Type	Name	Online / Offline	Date (Duration)	Place	Target Group	Short Description	No. of Participants/ Visitors/ Engagement	Link
Website article TUAS Rosenheim	Mit dem Gebäude der Zukunft zur klimaneutralen Stadt	Online	20.04.2020	Website Rosenheim Technical University of Applied Sciences	Professors, students, interested public and visitors of the website	Introduction to the SDE 21/22 and the research priorities and goals of levelup in the competition.	In total 235 views (as March 2022)	Click here
Website article regional newspaper	„Das ist eine Wissenschaft für sich“	Offline + Online	15.06.2020	Website Oberbayerisches Volksblatt	Public in the city and district of Rosenheim	Presentation of the progress in the SDE 21/22 competition aind impressions of everyday work.		Click here
„External newsletter TUAS Rosenheim“	Mit dem Gebäude der Zukunft zur klimaneutralen Stadt / Solar Decathlon Europe	Online	01.07.2020	E-Mail	University partners from industry and research	Information on the competition and the participation of TH Rosenheim	In total 1000 views (as March 2022)	
Regional newspaper	„Technische Hochschule Rosenheim: Wettbewerb „“Solar Decathlon Europe““ auf 2022 verschoben“	Offline + Online	30.09.2020	Oberbayerisches Volksblatt	Public in the city and district of Rosenheim	Introduction to the SDE 21/22 competition and notification of corona-related shift.		Click here
„External newsletter TUAS Rosenheim“	Sponsor*innen, Partner*innen und Wissensträger*innen gesucht	Online	14.10.2020	E-Mail	University partners from industry and research	Call for supporters and sponsors for the levelup team in the SDE 21/22 competition	In total 1000 views (as March 2022)	
„Magazine TUAS Rosenheim Yearly report of the Faculty of Wood Technology and Building“	Solar Decathlon Europe: Mit dem Gebäude der Zukunft zur klimaneutralen Stadt	Offline	31.12.2020	Online brochure	Professors, students, partners and industry	Insight into the competition and information about the involvement of the wood technology and construction faculty in the SDE 21/22.		Click here
„Internal newsletter TUAS Rosenheim“	Team levelup jetzt auf Social Media	Online	29.01.2021	E-Mail	Professors, scientific staff, students	Paying attention to our social media channels to generate more followers (LinkedIn, Instagram, Facebook, YouTube).	In total 600 views (as March 2022)	
Website article Bayerische Ingenieurkammer Bau	Internationaler Hochschulwettbewerb Solar Decathlon Europe 2021 mit TH Rosenheim	Online	17.02.2021	Online	Construction industry, engineers and architects, investors, R&D	Introduction to the SDE 21/22 and the research priorities and goals of levelup in the competition.		Click here
„External newsletter TUAS Rosenheim“	Bund und Land fördern Forschungsprojekt	Online	17.02.2021	E-Mail	University partners from industry and research	Inform on the official funding commitment from the federal and state governments.	In total 1000 views (as March 2022)	
Website article Bavarian State Ministry for Housing, Construction and Transport	Internationaler Hochschulwettbewerb zu Wohnraum der Zukunft	Online	17.02.2021	Online	Visitors from website, interested public, engineers, specialist planners from building industry	Presentation of the levelup team and their vision in the betting competition as well as support through public funding (Bavarian State Ministry for Housing, Construction and Transport)		Click here
Website article Energiezukunft Rosenheim (ezro)	Teilnahme der Technischen Hochschule Rosenheim am Solar Decathlon Europe 21/22	Online	23.02.2021	Online	Energy consultants, engineers, architects, students	Presentation of team levelup and introduction of the SDE 21/22 competition.		Click here
Professional magazine Sonnenenergie (German Society for Solar Energy)	Solar Decathlon Europe 21/22	Online	01.03.2021	„Magazine Sonnenenergie ISSN-Nr.: 0172-3278“	Professional audience from the solar industry	The team levelup has initiated a series of articles in the scientific journal, presenting the competition and all german teams.		Click here
„External newsletter TUAS Rosenheim“	Bund und Land fördern gemeinsam den Solar Decathlon Europe	Online	01.03.2021	E-Mail	Professors, scientific staff, students	Inform on the official funding commitment from the federal and state governments.	In total 600 views (as March 2022)	
Website article Sparkassenstiftung Zukunft Stadt und Landkreis Rosenheim	Solar Decathlon Europe 2021 - Förderung der Teilnahme an dem internationalen studentischen Wettbewerb	Online	01.03.2021	Online	Interested public and visitors of website	Press release about the foundation‘s contribution and presentation of the SDE 21/22-competition.		Click here
Regional newspaper	Mehr Wohnraum für weniger Geld: Rosenheimer Studenten wollen nachhaltiges Konzept kreieren	Offline + Online	05.03.2021	Oberbayerisches Volksblatt	Public in the city and district of Rosenheim	Presentation of the levelup-concept and vision of our team levelup.		Click here
Website article TUAS Rosenheim	Freistaat unterstützt Studierenden-Team beim SDE 21	Online	05.03.2021	Online	Professors, students, interested public and visitors of the website	Information about the State of Bavaria‘s sponsorship of the TUAS Rosenheim in the SDE-competition.	In total 156 views (as March 2022)	Click here
Podcast	Solar Decathlon Team Rosenheim	Online	01.04.2021	Online	Professors and students	Introducing the competition and raising awareness of our team at the university.		Click here

Website article Vela Solaris AG	levelup mit Polysun von Vela Solaris AG	Online	01.05.2021	Online	Engineers and specialist planners in the field of renewable energies	Announcement of support with software licences and short introduction into the SDE 21/22.		Click here
Website article ALPI Deutschland	TH Rosenheim nutzt Caneco im Solar Decathlon Europe-Wettbewerb ein	Online	21.05.2021	Online	BIM planners, engineers, specialist planners	Announcement of support with software licences and short introduction into the SDE 21/22.		Click here
„External newsletter Team levelup TUAS Rosenheim“	June-Newsletter levelup TUAS Rosenheim | SDE 21/22	Online	30.06.2021	E-Mail	Partners and sponsors of the levelup team	Update of our image film, our location at the Solar Campus for the competition in Wuppertal in June 2022, introduction of our student team	In total 50 views (as March 2022)	
„External newsletter TUAS Rosenheim“	Mit dem Gebäude der Zukunft zur klimaneutralen Stadt	Online	13.07.2021	E-Mail	University partners from industry and research	Update on current developments in the research project and competition, showing initial results.	In total 1000 views (as March 2022)	
Website article TUAS Rosenheim	Vorausstellung der Solar Decathlon Europe 21/22 Wettbewerbsbeiträge (Design Challenge)	Online	22.07.2021	Online	Professors, students, interested public and visitors of the website	Report and presentation of the exhibition of the architectural models in Wuppertal.	In total 66 views (as March 2022)	Click here
„External newsletter Team levelup TUAS Rosenheim“	July-Newsletter levelup TUAS Rosenheim | SDE 21/22	Online	30.07.2021	E-Mail	Partners and sponsors of the levelup team	The existing building in Nuremberg, visualizations of the extension, exhibition of our architectural model in Wuppertal	In total 50 views (as March 2022)	
Website article TUAS Rosenheim	Ausstellungsbeiträge Solar Decathlon Europe 21/22 nun vollständig (Design and Building Challenge)	Online	20.08.2021	Online	Professors, students, interested public and visitors of the website	Update on the architecture exhibition in Wuppertal with focus on our two models for the Design and Building Challenge.	In total 97 views (as March 2022)	Click here
Professional magazine Sonnenenergie (German Society for Solar Energy)	Solar Decathlon Europe 21/22 - Teil 3: levelup (Rosenheim) und MIMO (Düsseldorf)	Offline	01.09.2021	„Magazine Sonnenenergie ISSN-Nr.: 0172-3278“	Professional audience from the solar industry	The article presents the Design Challenge and focuses on energy production. In addition, the competition is summarised again in brief.		Click here
Website article TUAS Rosenheim	Idee sucht Team	Online	23.09.2021	Online	Professors, students	Call for new team members.	In total 340 views (as March 2022)	Click here
Internal newsletter TUAS Rosenheim	Solar Decathlon Europe 21/22 Vorausstellung	Online	30.09.2021	E-Mail	Professors, scientific staff, students	Information about the presentation of the architectural models in Wuppertal.	In total 600 views (as March 2022)	
Podcast	Talent Talk mit Marcus Wehner „Team levelup“	Online	01.10.2021	Spotify	Experts from timber construction industry	Kick-off the Talent Talks of Holzbau Netzwerk Deutschland. The competiton and our levelup project were presented with a focus on timber construction.		Click here
„Internal newsletter TUAS Rosenheim“	Solar Decathlon Europe 21/22 Baustart	Online	11.10.2021	E-Mail	Professors, scientific staff, students	Solar Decathlon Europe 21/22: Construction of the House Demonstration Unit to start this autumn	In total 600 views (as March 2022)	
„External newsletter Team levelup TUAS Rosenheim“	September-Newsletter levelup TUAS Rosenheim | SDE 21/22	Online	14.10.2021	E-Mail	Partners and sponsors of the levelup team	Visualization of the House Demonstration Unit (HDU), from the Design to the Building Challenge, model building and exhibition in Wuppertal, Germany.	In total 58 views (as March 2022)	
„External newsletter Team levelup TUAS Rosenheim“	October-Newsletter levelup TUAS Rosenheim | SDE 21/22	Online	31.10.2021	E-Mail	Partners and sponsors of the levelup team	Our Team at: SDE 21/22 Teamworkshop #2, Wuppertal, Forum Neue Energiewelt, Berlin, The smarter E Europe, Munich	In total 57 views (as March 2022)	
„Internal newsletter TUAS Rosenheim“	Solar Decathlon Europe 21/22 Baustart	Online	01.11.2021	E-Mail	Professors, scientific staff, students	Solar Decathlon Europe 21/22: Construction of the House Demonstration Unit to start this autumn	In total 600 views (as March 2022)	
„External newsletter Team levelup TUAS Rosenheim“	November-Newsletter levelup TUAS Rosenheim | SDE 21/22	Online	30.11.2021	E-Mail	Partners and sponsors of the levelup team	Trip to Dubai for the Solar Decathlon Middle East, preparations for the start of construction of the HDU, first semester fair at the TH Rosenheim	In total 49 views (as March 2022)	
„External newsletter Team levelup TUAS Rosenheim“	December-Newsletter levelup TUAS Rosenheim | SDE 21/22	Online	22.12.2022	E-Mail	Partners and sponsors of the levelup team	Start of construction of the House Demonstration Unit and progress, as well as christmas wishes to our partners	In total 48 views (as March 2022)	
„Website DETAIL Zeitschrift für Architektur + Baudetail“	Eine Zukunft für den Bestand (6): Projekt „levelup“ der Hochschule Rosenheim	Online	16.12.2021	Website DETAIL-Verlag	Architects, construction industry, engineers	Presentation of the team levelup and their concept for the competition entry		Click here
Website article TUAS Rosenheim	Solar Decathlon Europe: Richtfest beim Projekt „levelup“	Online	25.01.2022	Website Rosenheim Technical University of Applied Sciences	Professors, students, interested public and visitors of the website	Article about the topping-out ceremony of the House Demonstration Unit on the campus of the university.	In total 16 views (as March 2022)	Click here
„Website article Samerberger Nachrichten“	Richtfest bei TH Rosenheim - Solar Decathlon Europe 21/22	Online	25.01.2022	Website Samerberger Nachrichten	Public in the city and district of Rosenheim	Article about the topping-out ceremony of the House Demonstration Unit on the campus of the university.		Click here
Television report RFO	Solargebäude der Zukkunft der TH Rosenheim	Online	25.01.2022	Regional Fernsehen Oberbayern	Public in the city and district of Rosenheim	TV report on the topping-out ceremony of the House Demonstation Unit.		Click here

Regional newspaper	Endspurt für das Projekt der TH Rosenheim im Wettbewerb Solar Decathlon Europe	Offline + Online	28.01.2022	Oberbayerisches Volksblatt	Public in the city and district of Rosenheim	Report on the topping-out ceremony of the House Demonstration Unit		Click here
„Internal newsletter TUAS Rosenheim“	Solar Decathlon Europe: Richtfest vom Team levelup	Online	31.01.2022	E-Mail	Professors, scientific staff, students	Report on the topping-out ceremony of the House Demonstration Unit	In total 600 views (as March 2022)	
„External newsletter TUAS Rosenheim“	Solar Decathlon Europe 21/22: Richtfest beim Projekt „levelup“	Online	14.02.2022	E-Mail	University partners from industry and research	Report on the topping-out ceremony of the House Demonstration Unit	In total 1000 views (as March 2022)	
„Website article Sponsor STEICO SE“	STEICO unterstützt TH Rosenheim beim Solar Decathlon	Online	18.02.2022	STEICO Website	Timber construction sector, building industry	Report on STEICO SE's support with building materials		Click here
„External newsletter Team levelup TUAS Rosenheim“	February-Newsletter levelup TUAS Rosenheim | SDE 21/22	Online	03.03.2022	E-Mail	Partners and sponsors of the levelup team	Information on the timber module construction, the topping-out ceremony and our third place in the „10 Years Efficiency House Plus“ theme competition	In total 83 views (as March 2022)	
Local magazine	Endspurt für das Team „levelup“ der TH Rosenheim	Offline	01.03.2022	Magazine Rosenheimer Journal Heft 1, 39. Jahrg./B 5194 F	Public in the city and district of Rosenheim	The article provides an insight into the „levelup“ project and reports on the topping-out ceremony.		
Article Campushunter	Solar Decathlon Europe: Die Bauarbeiten haben begonnen	Online	01.03.2022	Website Campushunter	Students	Article about the construction of the House Demonstration Unit and topping-out ceremony		

CESA IMPLEMENTATION LIST

Deliverable No. D#6

Team ID ROS

University/ City Rosenheim

Education

Type	Name	Online / Offline	Date (Duration)	Place	Target Group	Short Description	No. of Participants/ Visitors/ Engagement	Link
Experts Symposium	„7. Brennpunkt Alpines Bauen: Das Gebäude als Baustein der Energiezukunft“	Online	01.10.2020	Online event	„Construcion industry, building sector, R&D, engineering consultants, architects, investors“	The Rosenheim Technical University of Applied Sciences is co-organiser. The latest developments from research as well as showcase projects from the construction industry were presented, demonstrating that building and energy production are also possible in a sustainable way. Our levelup team used the platform to draw attention to the SDE 21/22 and itself in order to network with potential partners and sponsors.	„5 participants from team levelup / several hundred visitors resp. participants / use of breakout-sessions for networking and raise awareness for SDE 21/22 and levelup“	Click here
Conference	„21. Forum Neue Energiewelt Leitkonferenz der neuen Energiewelt“	Online	19./20.11.2020	Online event	Energy and construction industry, R&D, start-ups, electricity grid operators, investors	For more than 20 years the expert symposium / conference has been the most important annual meeting for innovative companies seeking impulses and inspiration for the successful transformation of the energy system.	„3 participants from team levelup / serverhal hundred visitors resp. participants / supporting the organizer in the event and expaning the network for levelup in breakout-sessions and discussion rounds“	Click here
Experts Symposium	35. Symposium photovoltaische Solarenergie	Online	01./02.09.2020	Online event	PV-industry, R&D, engineering offices, solar technicians, start-ups, investors, electricity grid operators	Leading conference for all topics related to photovoltaics, from research to application	„5 participants from team levelup / serverhal hundred visitors resp. participants / supporting the organizer in the event and expaning the network for levelup in breakout-sessions and discussion rounds.“	Click here
Conference	28. Jahrestagung Arbeitsgemeinschaft Bayerischer Solar-Initiativen	Online	15./16.01.2021	Online event	Solar experts, public services, consultants, engineers, solar technicians, scientists, politicians, public	The ABSI (Arbeitsgemeinschaft Bayerischer Solar-Initiativen) organised a two-day conference on solar, climate change and a sustainable energy transition as part of their annual meeting.	„7 participants from team levelup / serverhal hundred visitors resp. participants / supporting the organizer in the event and expaning the network for levelup in breakout-sessions and discussion rounds“	Click here
Conference	Tagung zukünftige Stromnetze	Online	27./28.01 and 03./04.02.2021	Online event	Supply network operators, plant operators, energy and construction industry, R&D, solar experts, politicians	The conference is a source of inspiration and the most important meeting place for all key players in the energy sector with the core topic of power grids. At the conference, ideas and concrete proposals for solution to current and future challenges are highlighted and discussed in the interaction between politics, research and industry.	„2 participants from team levelup / several hundred visitors resp. participants / use of breakout-sessions for networking and raise awareness for SDE 21/22 and levelup“	Click here
Conference	4. Netzwerktreffen: Kommunales Energieeffizienz-Netzwerk Rosenheim-Traunstein	Online	24.02.2021	Online event	„Construcion industry, building sector, R&D, engineering consultants, architects, investors“	Annual meeting to exchange ideas and projects on energy efficiency issues in south-east upper bavaria.	„1 participant from team levelup / aprox. Hundred visitors resp. Participants / lecture on interim results with the focus on how innovative neighbourhoods and sustainable building materials can be used in social housing“	Click here
Conference	„NiM Netzwerktreff Energetische Quartiersentwicklung im Neubau“	Online	24.03.2021	Online event	Construction industry, project developers, municipalities, co-operatives and property developers, architects and building planners, engineers, contractors, system providers and component manufacturers, energy consultants and energy managers	Top-class specialist lectures, virtual topic rooms to join in the discussion, an exciting exchange with renowned industry experts and much more. The main topics include sector coupling, holistic energy concepts, flexibility and economic efficiency, hybrid energ systems, efficient building envelope	„2 participants from team levelup / aprox. one hundred visitors / we presented our team via a digital pinboard“	Click here
Conference	„Rosenheimer Klimafrühling 2021: Klimawandel stoppen - es ist höchste Zeit, legen wir los!“	Online	15.-17.04.2021	Online event	Broad professional audience from the renewable energy sector, interested public	Online lecture series with the Rosenheim Technical University of Applied Sciences, among others, is the main organizer and wants to draw attention to the topics of energy transition and climate change.	„5 participants from team levelup / aprox. two hundred visitors / expanding the network for levelup in breaktout-sessions and discussion rounds“	Click here

Experts Symposium	31. Symposium Solarthermie und innovative Wärmesysteme	Online	27.-30.04.2021	Online event	PV industry, R&D, engineering offices, solar technicians	Leading conference for all topics related to solar thermal power / sytems, from research to application.	„2 participants from team levelup / aprox. three hundred visitors / expanding the network for levelup in breaktout-sessions and discussion rounds“	Click here
Dialogue forum	Bayerisches Staatsministerium für Wohnen, Bau und Verkehr	Offline	14.05.2021	Munich	Politicians and experts from building industry	After invitation of Kerstin Schreyer, MdL Keynote speech at the Bavarian State Ministry for Housing, Construction and Transport.	„1 participant from team levelup / aprox. fifty participants / lecture, presentation on highlighting potentials in the renovation of old buildings and their contribution to the climate neutrality of cities“	
Experts Symposium	36. Symposium photovoltaische Solarenergie	Online	18.-21.05.2021	Online event	PV-industry, R&D, engineering offices, solar technicians, start-ups, investors, electricity grid operators	Leading conference for all topics related to photovoltaics, from research to application	„5 participants from team levelup / several hundred visitors resp. participants / Presentation of scientific poster „“CO2-neutrality and plus energy through refurbishment and building extension in urban areas: Designs for the Solar Decathlon Europe 21/22““	Click here
Conference	„22. Forum Neue Energiewelt Leitkonferenz der neuen Energiewelt“	Offline	22./23.09.2021	„Berlin (Festsaal Kreuzberg)“	Energy and construction industry, R&D, start-ups, electricity grid operators, investors	For more than 20 years the expert symposium / conference has been the most important annual meeting for innovative companies seeking impulses and inspiration for the successful transformation of the energy system.	„4 participants from team levelup / severhal hundred visitors resp. participants / we presented a keynote speech „“With visionary science and the building of the future to the climate-neutral city - Competition entry of TUAS Rosenheim at the SDE 21/22““	Click here
Conference	Rosenheimer Fenstertage 2021	Offline	14.10.2021	Rosenheim	Professional audience from the construction industry	Specialist conference on the topic of building physics.	„1 participant from team levelup / aprox. Hundred visitors resp. Participants / lecture, presentation on research focus of team levelup with a concentration on ousing expansions and the use of sustainable materials in construction (Nachhaltige Wohnraumerweiterung: klimaneutral, reyklierbar und biodivers)“	Click here
Conference	Architektourlounge 2021	Offline	21.10.2021	Kufstein (Austria)	Professional audience from the construction industry	Specialist conference on the topic of visionary architecture.	„1 participant from team levelup / aprox. hundred visitors resp. participants / lecture, presentation on research focus of team levelup with a concentration on ousing expansions and the use of sustainable materials in construction (Klimaneutral, kreislauffähig, flächeneffizient - Konzepte für nachhaltige Wohnraumerweiterung)“	
Dialogue forum	Bauindustrie-Verband Bayern	Offline	11.11.2021	Munich	Professional audience from the construction industry	Specialist conference on the topic of building industry.	„1 participant from team levelup /aprox. hundred visitors resp. participants / lecture, presentation on climate-neutral, recyclable, space-efficient - two concepts for sustainable housing extensions“	
Conference	3. Rosenheimer Klimafrühling / 29. Jahrestagung der Arbeitsgemeinschaft Bayerischer Solar-Initiativen	Online	11./12.02.2022	Online event	Solar experts, public services, consultants, engineers, solar technicians, scientists, politicians, public	The ABSI (Arbeitsgemeinschaft Bayerischer Solar-Initiativen) organised a two-day conference on solar, climate change and a sustainable energy transition as part of their annual meeting.	„5 participants from team levelup / 750 participants / levelup was co-organizer and presented a speech on the competition entry at SDE 21/22“	Click here
Conference	Informations- und Kompetenzzentrum für zukunftsgerechtes Bauen	Online	23.03.2022	Online event	„Construcion industry, building sector, R&D, engineering consultants, architects, investors“	In cooperation with the Solarzentrum Berlin and the consortium management of the scientific accompanying research Energiewendebauen, a free lecture of the German teams on SDE 21/22 will be organised.	N.N. - follows	Click here

CESA IMPLEMENTATION LIST

Deliverable No. D#6

Team ID ROS

University/ City Rosenheim

Social Awareness

Type	Name	Online / Offline	Date (Duration)	Place	Target Group	Short Description	No. of Participants/ Visitors/ Engagement	Link
Social Media	levelup_ro	Online		Instag-ram	Students and young generation	On our instagram channel, we target young audiences and draw attention to our team and developments. We also raise awareness about the disciplines in the SDE 21/22.	In total 539 follower (as of March 2022)	Click here
Social Media	levelup Rosenheim	Online		LinkedIn	Professional audience, partners, sponsors, professionals	On LinkedIn, we focus on high-quality and informative professional news.	In total 301 follower (as of March 2022)	Click here
Social Media	levelup	Online		Face-book	Students and young generation	On our Facebook channel, we target young audiences and draw attention to our team and developments. We also raise awareness about the disciplines in the SDE 21/22.	In total 104 follower (as of March 2022)	Click here
Social Media	levelup Rosenheim	Online		Youtube	broad and interested public	We use the YouTube platform to store videos and to communicate / link to other channels.	In total 5 follower (as of March 2022)	Click here
Website	levelup-ro	Online		World Wide Web	broad and interested public	On our website we try to cover all topics of the competition and our team. The website provides further and supplementary information that has no place on social media.	In total 681 views (as of March 2022)	Click here
Event	Topping-out ceremony	Offline	24.01.2022	„Rosen-heim Campus“	Politics, sponsors from inudstry and research, students, professors, scientific staff, media (radio, television, print media)	Topping-out ceremony for the House Demons-tration Unit incl. several speeches on the topic of redensification in urban spaces to raise social awareness of what future life in the city of tomor-row may look like. Due to Covid-19 restrictions, this was the only event possible so far.	„50 participants from team TUAS Rosenheim / 50 guests from team levelup / Organisation of the entire cele-bration incl. lectures, catering, press media, etc.“	Click here Click here Click here
Event	Opening celebration	Offline	„End of April / Beginning of May 2022“	„Rosen-heim Campus“	Politics, sponsors from inudstry and research, students, professors, scientific staff, media (radio, television, print media)	We are planning an opening ceremony of the House Demonstration Unit and would like to create awareness about the 10 disciplines in the competition.	follows	
Guided tours		Offline	„End of April / Beginning of May 2022“	„Rosen-heim Campus“	Students and pupils, professors, scientific staff, interested public	Guided tours of the House Demonstration Unit are currently under planning to raise awareness about climate-neutral and sustainable building. In addition, the SDE 21/22 is to be promoted more strongly.	follows	

39 Sustainability Report

Table of contents

1. Circularity

1.1 Materials

In the selection of materials and constructions for the „levelup“ system, the focus is on renewable bio-based raw materials or secondary raw materials and the principle of „design for disassembly“. „All of our constructions are planned and designed in such a way that they can be dismantled at the end of their life cycle and each material is available separately. For this reason, we completely dispense with glued constructions; even for the bathroom, we were able to develop a construction with mechanically fastened seals. Our building components consist to a very large extent of wood from sustainable forestry and are almost 100 % recyclable. This minimises the impact on the environment, climate and quality of life even after the life cycle. The wood used in the project is, if possible, untreated or, if necessary, glazed with bio-based and pollutant-free oils. After deconstruction from our building, all woods are at least waste wood class 2 and can thus be further used in cascades. The CO2 stored in the material can remain in the building material in the long term and serve as a global greenhouse gas sink.
We are pursuing two further overarching goals with our competition entry. Firstly, the development of a „levelup“ extension & renovation SYSTEM and secondly, a feasible solution also for subsidised housing construction. In our decision-making processes, we therefore always strive to find solutions that are feasible and affordable on an industrial scale.

After the competition, our building will be rebuilt in Rosenheim and used in the long term as a daycare centre and family office. For this reason, we placed very great emphasis on durable, non-critical construction and materials, foregoing many an experiment in favour of safety. We also take into account the extreme loads caused by assembling and dismantling our building twice and transporting it twice using robust construction.

Overall, the Excel tool „Urban Mining Index -UMI“ from the University of Wuppertal gives us a very good Urban Mining Indicator of 82.4 % for our main components - exterior wall, windows, elevated floor plate, ceiling, roof and interior wall. As shown below for the individual components, our materials can be almost completely recycled at the end of their life (post-use). The only outlier is our ceiling insulation, which will be discussed in detail later.
Overall, we have a very large proportion of wood from sustainable forestry (pre-use) in our main components. Here we have a few raw materials from secondary use, i.e. few recycled materials. On the one hand, this has to do with the fact that we were, fortunately, able to win many sponsors from the wood industry who supplied us with their new products; on the other hand, our approach is to develop a system that can be implemented on a large scale. From our point of view, there is currently a lack of comprehensive resources of secondary materials. For this reason, our pre-use phase usually turns out worse than the recyclability in our post-use phase.

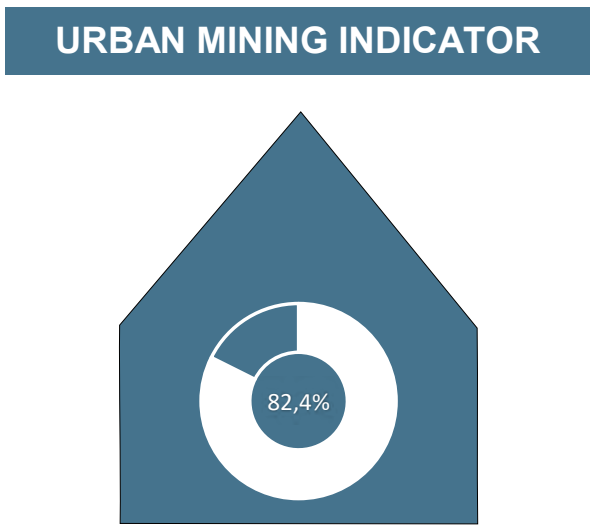


Figure 1 – Urban Mining Indicator of the main building components of our HDU.

In interior finishing and furniture construction, on the other hand, we mainly use secondary raw materials. However, these are not recorded in the UMI and therefore do not appear in the calculations. For resource and cost reasons, we have dispensed with solid wood in our built-in furniture, for example. Here we use sustainable Beyond particleboard from Swiss Krono, which is made of 100% recycled wood and 97% of the binders are made of renewable bio-based raw materials. The Beyond board is 100% recyclable in the post-use phase, only the removable melamine resin coating can only be thermally recycled. By using chipboard, we can also demonstrate different cascade stages of wood used at our HDU, from untreated solid wood to chipboard.

In our bathroom, large-format wall and floor panels made of waterproof Resysta® panels from rice waste are used. In the spirit of Design for Disassembly, the panels are installed without glue. This allows for quick and damage-free maintenance and separation by type. The material is waterproof and can be used without further surface treatment. This enables complete recycling at the same quality level.

As a further secondary raw material, we use Cradle to Cradle® certified glass-ceramic panels from Magna Glaskeramik® for our kitchen worktops. The product is made of 100% recycled glass bottles, which is predominantly produced with renewable energy.

With the secondary raw materials we have selected, we want to make the industrial and economic use of recycled materials in the interior of the HDU tangible for the visitor.

Exterior wall
Our exterior walls are predominantly made of sustainable wood in the form of solid wood or softwood fibre insulation. The solid wood walls with diagonal formwork are mechanically joined without glue using Lignoloc® wood nails - a development of the TH Rosenheim with the Beck company. After use in our building, they can be separated more easily than with the usual metal nails or processed straight away as a single material for the next cascade stage. The wooden nails are made of Central European beech from sustainable FSC forestry. Compared to other fastening systems, more than 70% less CO2 emissions are caused.

As described at the beginning, we have very high recyclability at the end of the life cycle, as we install predominantly wood from sustainable forestry in terms of mass.

On the inside, the walls are planked directly with Claytec clay building boards without diagonal formwork. We use clay building boards with a jute reinforcement fabric and not with glass fibre fabric as is often used. Since we do not use an installation level and can screw our boards directly to the solid wood wall, it is possible to do without glass fibre reinforcement. For this reason, our clay building boards can be 100% recycled, i.e. shredded and used again as clay building boards in a closed cycle or composted completely. The boards are made of natural and regional raw materials that contribute significantly to a healthy and comfortable living climate and protect the wooden construction from moisture and fire.
We use a silver fir triple-layer panel as the cladding for the ventilated façade. The façade can be assembled and disassembled quickly, without sorting and damage, using a simple wooden suspension system. On the south façade, BIPV glass-glass modules are attached to the rear-ventilated timber UK as façade cladding (not calculated in the UMI table). These modules can also be removed without damage.

For safety reasons, we install a vapour barrier in addition to ESB panels, as we do not want to risk any experiments regarding moisture damage during permanent subsequent use. The same applies to the ceiling. The foil can be removed at the end of its life cycle.

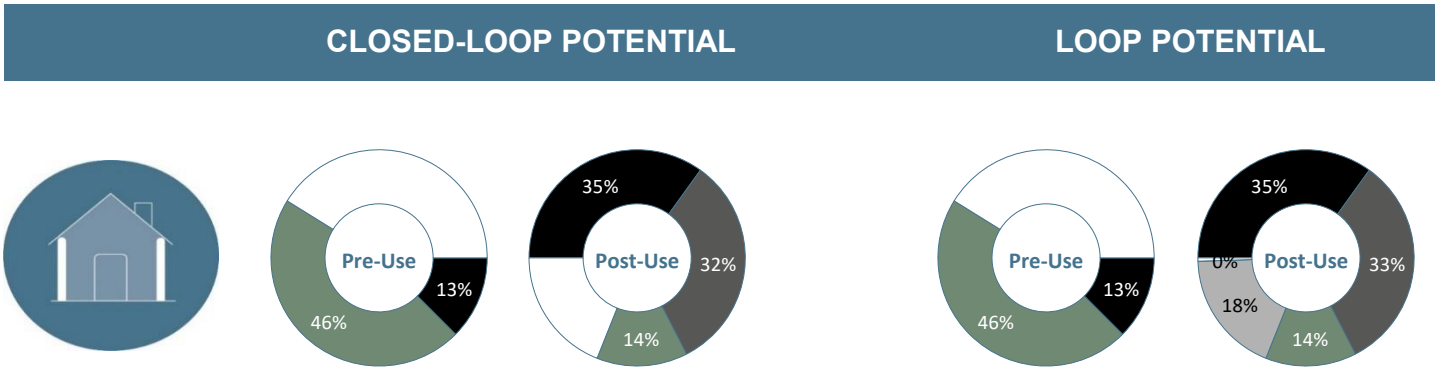


Figure 2 – UMI result exterior wall.

Windows
Our windows consist of wood-aluminium frames and vacuum-insulated glazing. Due to the long durability and low maintenance requirements, also in consultation with our project partner the state housing association Siedlungswerk Nuremberg, we decided on wood-aluminium frames. Such windows are now also used in subsidised housing construction.

The vacuum glazing is sponsored by our partner Fineo and Interpane by AGC. Due to the exploding krypton prices, corresponding vacuum glazing is also becoming economically more interesting. With an extremely good Uw value of 0.4 W/m^{2}K, the glazing is extremely slim at approx. 23 mm. It consists of three flat glass panes with a space between the panes (1 mm) with vacuum and an SZR (10 mm) with argon gas.

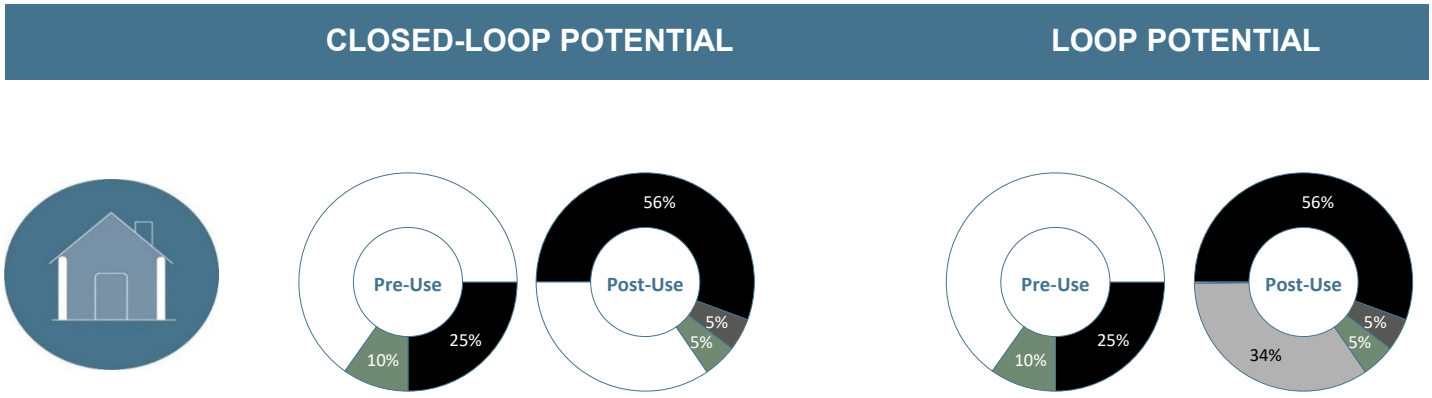


Figure 3 – UMI results window

The windows can have one hundred percent loop potential.

Interior wall
Our HDU has very few interior walls, as the room is partly divided by built-in furniture and we have a very open floor plan. The few walls we have consist of a wooden post and beam construction with Beyond chipboard on both sides, similar to our furniture. The Urban Mining result has a high recycling potential.

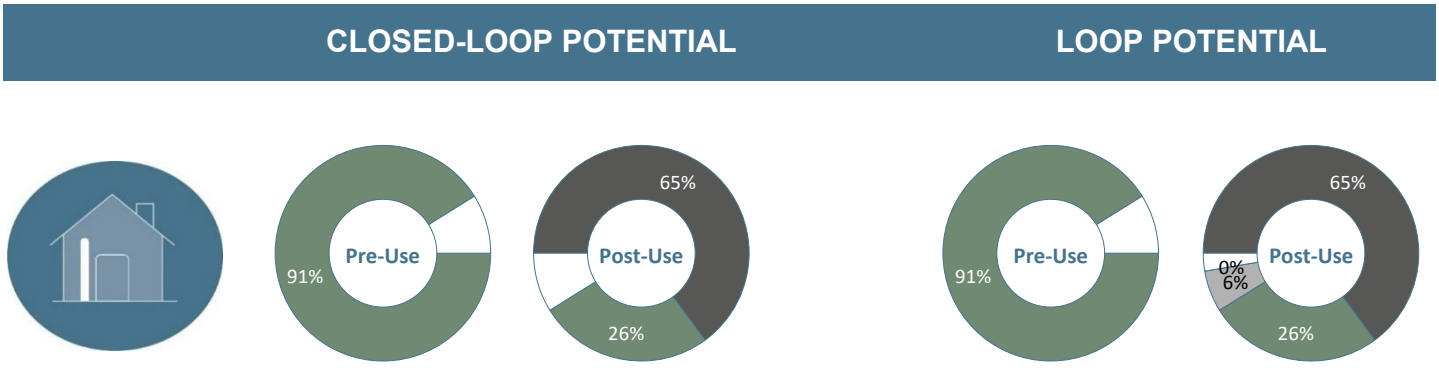


Figure 4 – UMI result interior wall.

Raised floor slab
Our building is elevated and can therefore be executed as a wooden construction. This floor structure is also dominated by wood from sustainable forestry. The floor structure is laid as a floating floor, i.e. all layers can be separated by type at the end of the life cycle. For economic reasons, a floating three-layer parquet is used rather than a solid wood floor. The underfloor heating is inserted with baffles in softwood fibre insulation. Clay building boards are used for the floor structure because of their good circulation properties.

For one component, we go for safety because of the permanent re-use in Rosenheim. The floor is clad from below with a Fermacell® Powerpanel H2O. The panel is a cement-bonded lightweight concrete slab with a sandwich structure
and top layer reinforcement on both sides made of alkali-resistant glass fibre mesh. The panel is screwed to the floor element and can be separated and disposed of at the end of its life.

In the „levelup“ system as an extension, a panel of gypsum fibreboard from Fermacell® could be attached at this point, as the moisture loads would be significantly lower. This variant would have higher recycling potential.

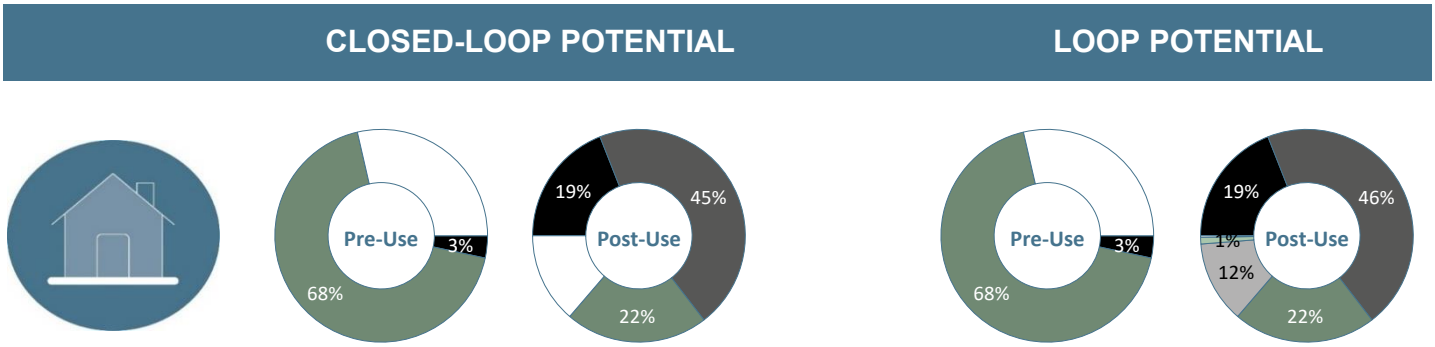


Figure 5 – UMI results elevated floor slab

Ceiling

The storey ceiling is the only building component that performs significantly worse than all other building components. Although the floor slab is also mainly made of sustainably managed wood, it has a special feature. Our heat and moisture simulations in WUFI, unfortunately, revealed critical situations with wood fibre insulation. As we did not want to take any risks due to long-term use, we opted for PIR flat roof insulation. Due to the height limitation of the Solar Envelope, we also had to use an insulation material with a low thermal conductivity to limit the ceiling construction height. The pressure-resistant and moisture-insensitive insulation made of polyisocyanurate consist of petroleum, which we would have very much liked to avoid completely.

For comparison, we performed the UMI calculations with an alternative softwood fibre insulation. The results would change significantly and correspond to the other components of our HDU, as can be seen in the calculation results below.

The overall Urban Mining Indicator would improve by 6.1% to 88.4%, as shown in the figure 8.

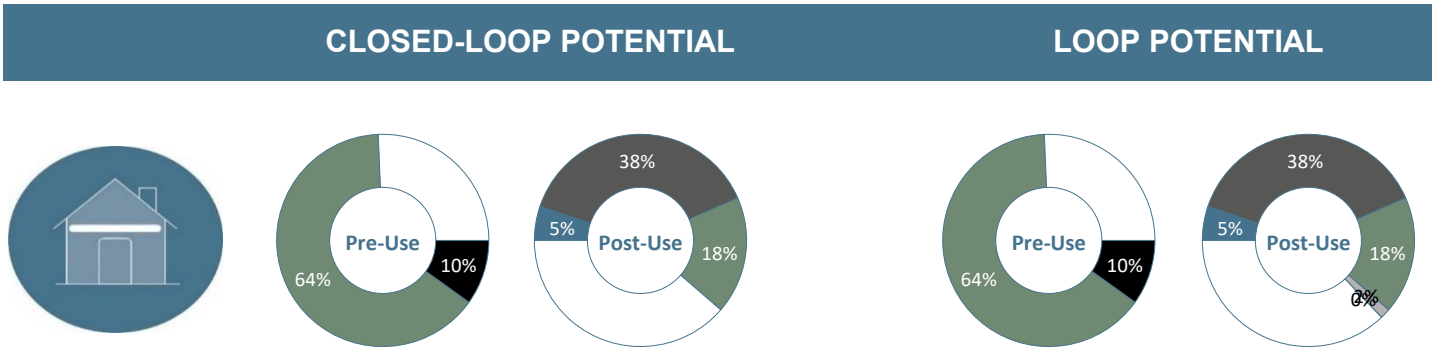


Figure 6 – UMI results ceiling with PIR insulation

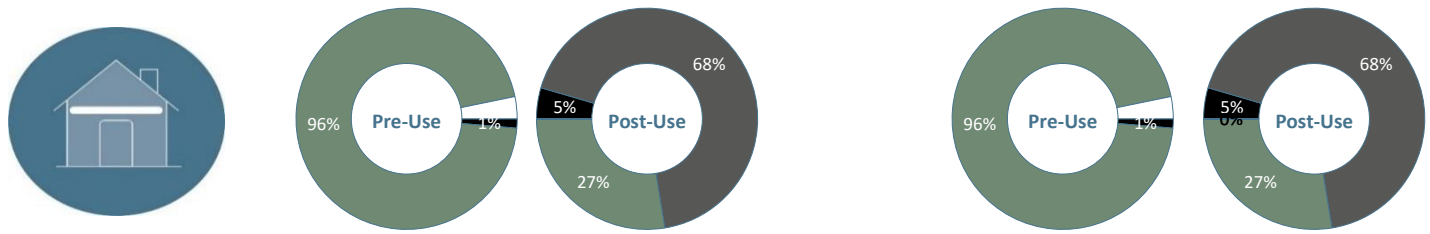


Figure 7 – UMI result ceiling variant with softwood fibre insulation as a substitute for PIR

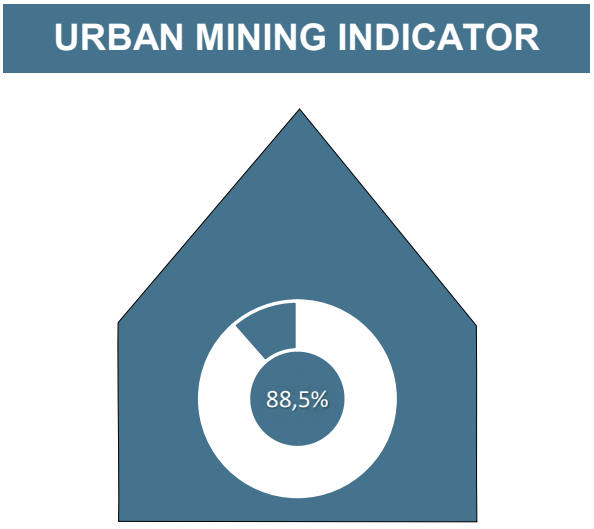


Figure 8 – Urban Mining Indicator for the entire building without PIR insulation

Roof

The roof construction above our technical room on the upper floor is also mainly made of wood from sustainable forestry. We opted for sheet metal waterproofing for reasons of durability and especially robustness. This can be prefabricated well, can be quickly assembled and disassembled and is not susceptible to damage. At the end of its life cycle, the entire roof construction can be separated and recycled according to type.

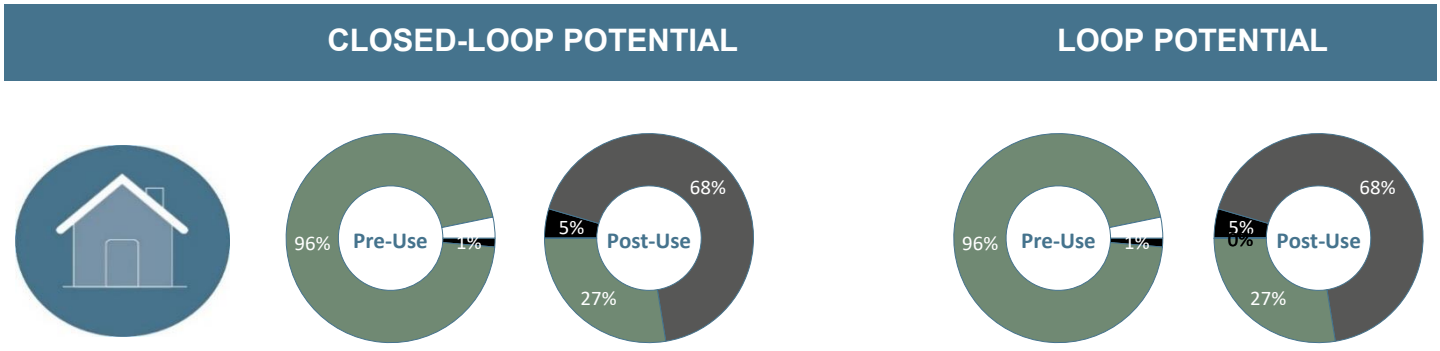


Figure 9 – UMI result roof

Other structural components have not been included in the calculations, including the staircase and pergola to and on the upper floor. It is designed as a steel structure. The external scaffolding structure on our overall „Design Challenge“ building with escape stairs, lifts, arcades and balconies cannot be made of wood. For this reason, we are also building the structure on the HDU in steel. Originally, we had planned to use recycled steel „XCarbTM“ from ArcelorMittal Europ. The steel is made of 100% recycled steel and is produced with 100% renewable energy. Unfortunately, the small profiles and HDU we need are not available. We, therefore, opted for conventional galvanised steel, preferring to save mass. Conventional steel can also be fed endlessly into the technical cycle according to the Cradle to Cradle® principle and therefore has great closed-loop potential.

Sustainability is also a priority in energy and building technology: for example, we use a propane heat pump from Ecoforest that can be installed indoors. A natural refrigerant like propane has a significantly lower greenhouse gas potential and its production and disposal at the end of its life is uncomplicated. But our inverters from Fronius are also characterised by sustainability. As early as the development stage, attention is paid to „sustainability by design“, with a focus on sustainable production, a long service life, short transport routes and the use of recycled materials and the reparability of the inverters.

1.2 Construction and maintenance

All components are mechanically fastened to allow for unmixed dismantling at the end of the building's life cycle and to be able to remove individual components without damage and unmixed during the period of use. Only the foil sheets are glued together. Here we have not dispensed with foils for moisture protection. After the competition, the HDU will be set up and operated permanently in Rosenheim as a day-care centre and family office on the campus and should be as durable as possible. The mass proportion of foils in the overall building is very low. All building components are screwed or nailed with wooden nails. It is therefore easy to dismantle the individual layers according to type. All façades are ventilated with mechanical fixings. The façade panels - wood or PV - can be easily replaced.

An absolute novelty is our silicone-free bathroom. Here, the Rosenheim University of Applied Sciences has developed a bathroom that dispenses with the usually bonded sealants. The walls and floors of the bathrooms are fully covered with waterproof Resystaplatten. The wall and floor elements can be easily removed and replaced. This also enables damage-free and quick maintenance of the installations behind them or the replacement of damaged wall and floor elements. Due to the water-resistance of the Resystaplatten, waterproofing, tiles and other typical wall and floor structures can be dispensed with. At the end of the life cycle, the Resystaplatten are available again sorted by type and can be 100% recycled. In the pre-use phase, they consist of 60 % waste materials (rice husks).

1.3 Circular economy concept

Since the principle of Design for Disassembly is consistently applied to all components, all materials can be dismantled and separated according to type at the end of the life cycle. The materials used to consist mainly of renewable raw materials or, if possible, of secondary raw materials (chipboard, Magna glass-ceramic, Resystaplatten). The materials used are mostly recyclable at the end of the life cycle, in the best case in a closed cycle.

The UMI calculations show a very positive result for the main components of our HDU with an Urban Mining Indicator of 82.4 %. If we were to replace the PIR insulation with softwood fibre insulation, we would reach 88.5 %.

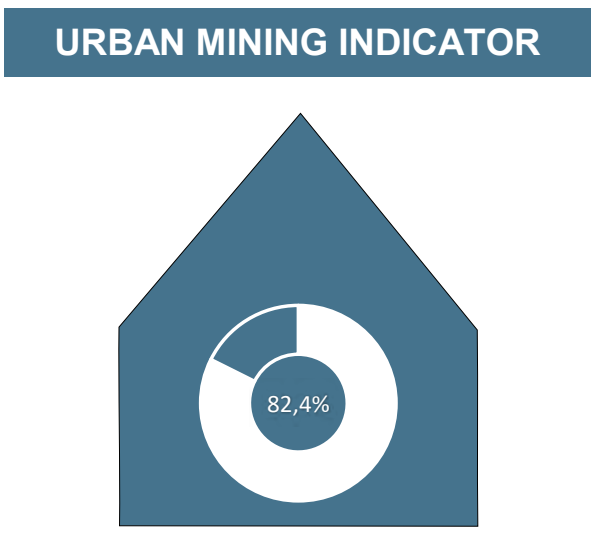


Figure 10 – Urban Mining Indicator of the main building components of our HDU.

1.4 Carbon footprint of the construction

At the present design phase, we are working with the Software Rhino (www.rhino3d.com) and Caala (www.caala.de). Caala offers the possibility of a parametric LCA, which shows the effects on the primary energy demand and the environmental impacts over the entire life cycle (phase A to C and D) in real-time in the case of planning changes. The HDU is created and constantly modified as a 3D model in Rhino (see Figure 1). Via a Caala plugin in Grasshopper, the model is transferred to the online tool Caala.

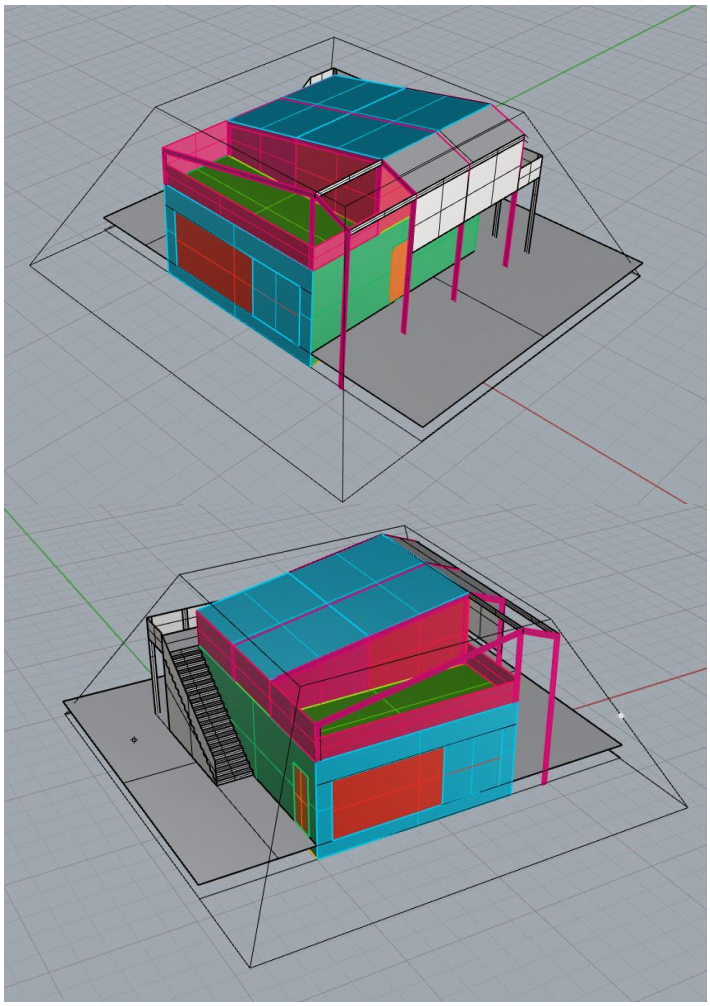


Figure 11 – HDU from the southeast (left) and southwest (right) / 3D model Rhino

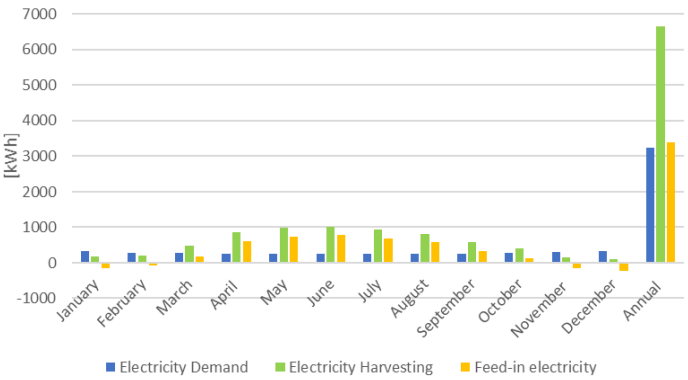


Figure 12 – Feed-in electricity based on monthly balance method according to DIN V 18599

Caala calculates the primary energy demand and the environmental impact of production, replacement, disposal and recycling of materials according to DIN EN 15978. The data basis is the Ökobaudat 2020, but data from EPDs (Environmental Product Declarations) of manufacturers can also be implemented and calculated. The energy demand in the use phase is calculated according to DIN V 18599. The energy supply from the photovoltaic surfaces is simulated with an integrated, simplified calculation model in Caala. The feed-in electricity into the grid is calculated in Excel in a simplified way using the monthly balance method according to DIN V 18599 (see Figure 2). With approx. 22 m^2 PV on the southeast façade and approx. 54 m^2 PV on the southwest-facing roof surface, electricity harvesting of 8893 kWh/a and electricity demand of 3340 kWh/a is determined in Caala. 5822 kWh of electricity per year can be fed into the grid.

The calculated primary energy demand in the use phase is 38 kWh/(m² a), by using an air-water heat pump and controlled living space ventilation. The heating requirement of 40 kWh/m²a included in this calculation is too high and must be reviewed in the further process.

When selecting materials, the aim is to use as many biogenic building materials as possible. Non-biogenic building materials are selected according to their recyclability. In addition to the building material qualities, feasibility and affordability play an important role, both for the construction of the HDU (dependence on material sponsoring) and for a possible real extension. The credits in phase D are not included in the given datasheet and correspond to the values in Figure 3.

The large use of biogenic building materials would result in significant credits in phase D (see Figure 4).

The current LCA gives a trend value. After completion of the design phase, more precise calculations with additional programmes will be integrated into the LCA. The energy demand in the use phase is currently set too high, and the electricity yields from the PV or PVT system are set too low. Furthermore, load management and electricity storage are not taken into account. Currently, the building materials are only calculated approximately with data from Ökobaudat, manufacturers' EPDs are not yet integrated. Furthermore, in the further course, the output databases from the BIM model can be accessed to increase the accuracy.

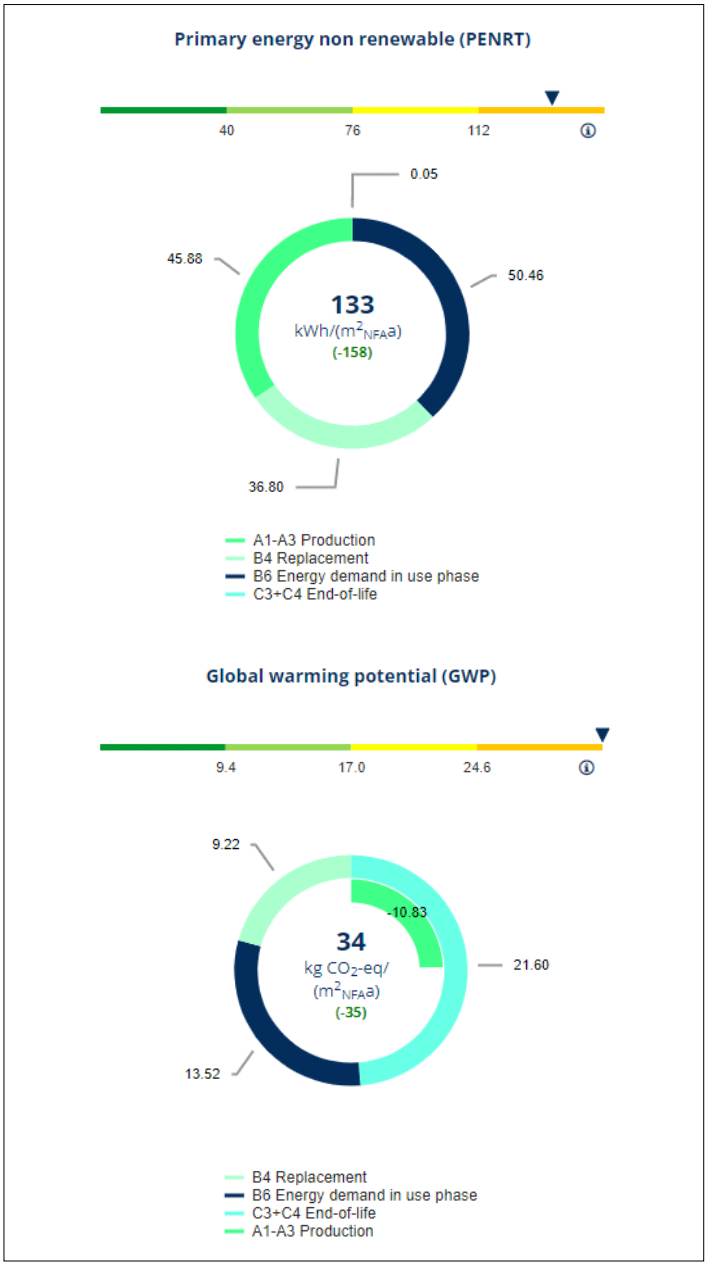


Figure 13 – Life Cycle Assessment HDU without phase D / Caala

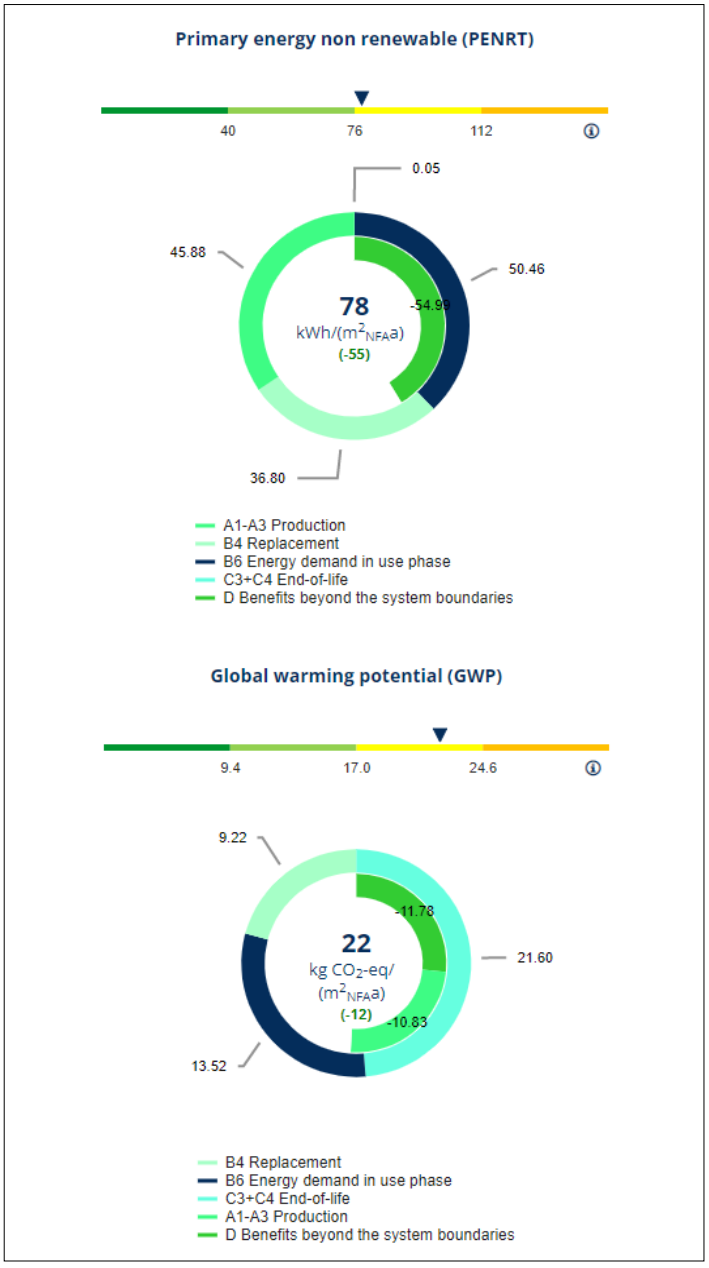


Figure 14 – Life Cycle Assessment HDU without phase D / Caala

2. Sufficiency, Flexibility & Environmental Performance

2.1 Biodiversity

Many positive motivations for the natural environment and land use go hand in hand with the construction of an extension. Existing green spaces in urban areas need to be preserved and expanded. Our elevation can implement this because the construction measures result in only minimal land sealing due to our elevations, and the majority of the existing site remains untouched. We also create additional green areas on the roof and façade and more biodiverse areas are created than are sealed. By leaving the natural topographies of the site largely untouched, we protect the soil and water cycles and the existing living organisms. Furthermore, habitat for new species is created and these areas contribute to the conservation of wildlife. If our system of elevation and accompanying greening were to be extended to the entire neighbourhood, a large contribution could be made to cool the urban microclimate. Biodiversity could be created that is currently not found in cities. Many creatures would find a habitat again and thus the biodiversity of the whole area would be promoted and built up. Rainwater and greywater can be used to irrigate the green areas, which are an ecological enhancement of the urban environment.

The exoskeleton on the north side of the building will serve as a trellis for the greenery on the façade. In the area of the lifts, a large-scale climbing scaffold for climbing plants is planned, extending over the entire height of about 24 metres. The area is to be extensively greened to create a habitat for insects and birds in the city. The areas that have balconies and arcades will be greened to a slightly lesser extent so as not to prevent light from entering. Soil-bound climbing plants such as the deciduous, native Clematis vitalba are particularly well suited to semi-shaded locations. It is fast-growing, richly flowering and tolerates heat and wind. However, as it only reaches a height of 15 m, it is necessary to divide the total distance and place an additional plant trough with irrigation in the area of the topiary. An alternative would be the wintergreen Fallopia baldschuanica, which offers all the more food for insects due to its long flowering period. In addition, plant troughs are to be installed in the areas of the balconies, where the residents have the opportunity to cultivate plants themselves and actively contribute to the greening of the building. The plants create a connection between the existing building and the addition and form a green carpet that extends across the entire façade. The greenery forms a unified overall image and connects the old with the new. The roof surfaces of the extension are divided into different types: Opaque roof surfaces with PV panels, glass surfaces to the interior green communal spaces, barrier-free accessible movement areas, areas for extensive and intensive roof greening.

Figure 15 – Green Areas
Year-round greenery in the indoor common areas.
Outside, green roof terraces and facade greening.

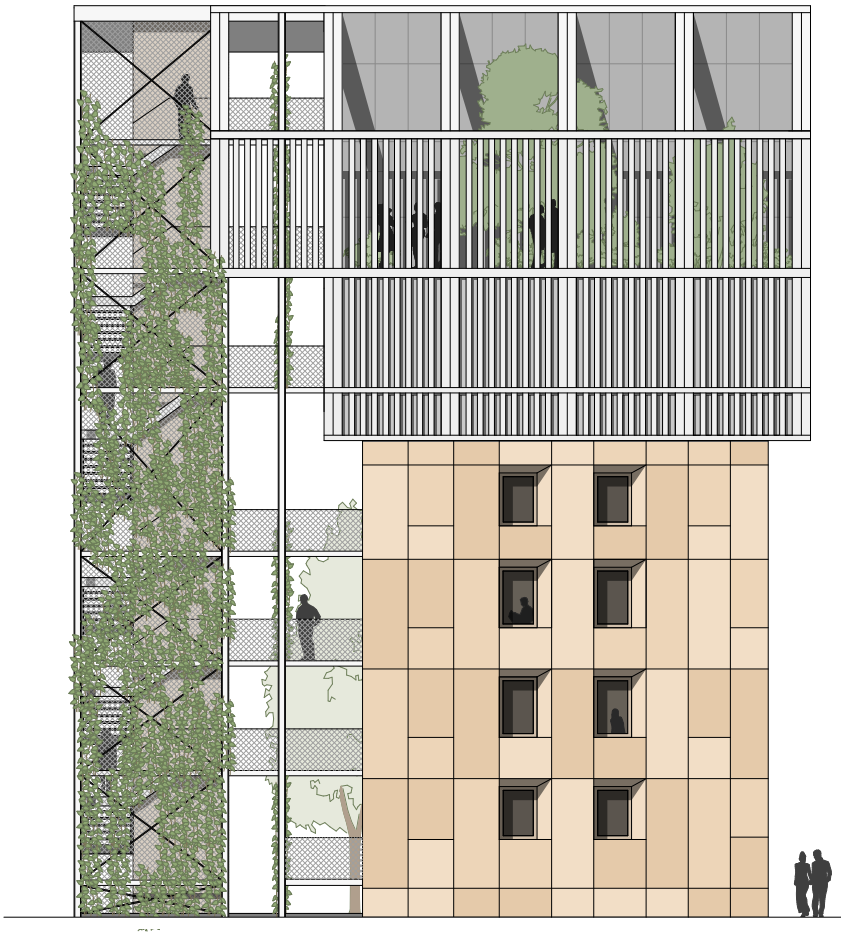


Figure 16 – Building Elevation Northwest with greenery

Extensive green roof areas are areas that are greatly reduced in the build-up height of the substrate so that only plants with a low growth height can grow there. As a rule, drought-tolerant plants are used that can withstand strong sunlight and intensive weather conditions and require little maintenance. Extensive green roofs are particularly suitable where accessibility for maintenance is difficult, costs for maintenance and irrigation are to be saved, and yet the value is placed on water retention, evaporative cooling and biodiversity. An extensive green roof is therefore planned for the northwest sloping areas, which will serve as a bee pasture. With a roof pitch of 22 and a substrate build-up of approx. 12-15 cm, plants with a minimum pot height are suitable. Plant genera such as Dianthus, Gypsophila, Sedum and Thymus are robust to the hot urban climate and, together with bulbous plants such as Allium, provide food for bees and insects during the flowering season between May and September. To create further ecologically valuable open spaces and expand the habitat for larger insects and birds as well, intensive roof greening is also planned on the accessible roof areas. With a substrate build-up of 30-50 cm, drought-tolerant flowering perennials and shrubs are to further extend the flowering period, provide nesting opportunities and provide shade in summer. In these areas, on the one hand, recreational oases are to be created that are creatively appealing for the residents of the building and allow them to retreat into the greenery. On the other hand, there will be small areas for urban agriculture where residents can grow their herbs and vegetables all year round.

Figure 18 – Urban Farming
Urban farming can be practiced by the residents on the roof of the extension. This encourages community and a connection to nature.

Figure 19 – habitat for animals
The flower-rich vegetation can be used as bee pasture and provides nesting opportunities for birds. This helps to increas biodiversity in the neighbourhood.

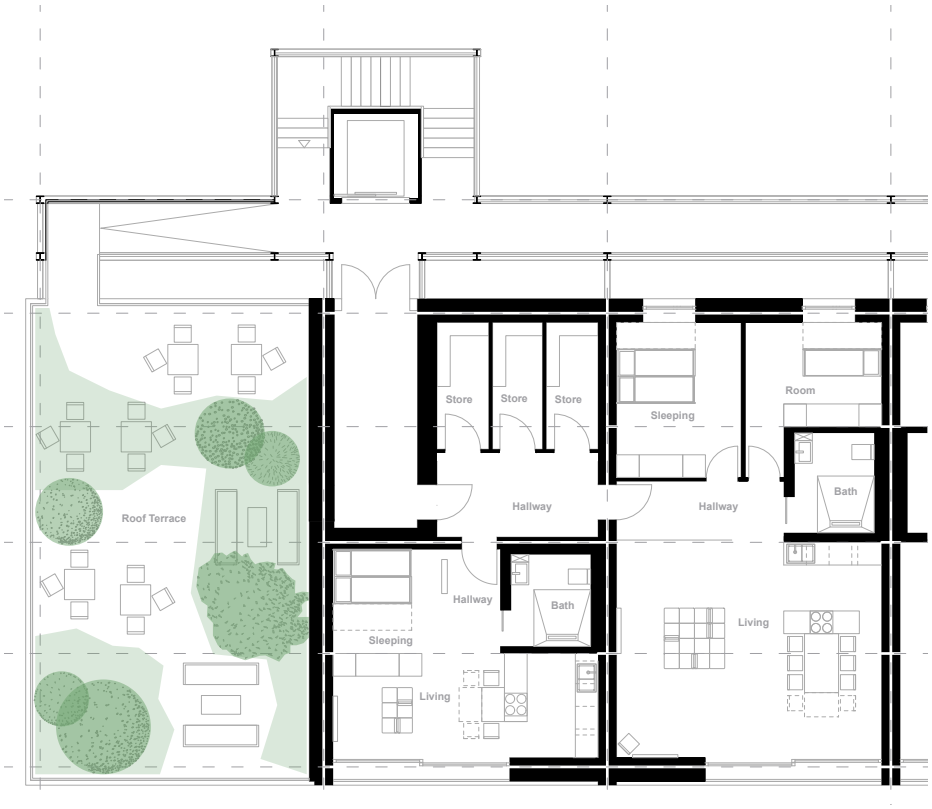


Figure 17 – Floor Plan Level 2 of the addition of storeys with a green roof terrace

Green areas are also found inside our building. The communal areas include spacious planted areas, which are optimally supplied with daylight through the large window areas on the façade and roof. These spaces can be used by all residents and the greenery helps to create a pleasant indoor climate. For the cool seasons, this allows the residents to spend time in nature and enjoy the pleasant atmosphere among plants. The common rooms are intended to serve as a place of calm and communication for the entire building.
Exterior lighting is designed to reduce light pollution. The HDU will have minimised external lighting, which will only directly illuminate the pathways. The LED light strips are recessed into the underside of the handrails and shine downwards onto the visitor path.

Figure 20 – Communal space with year-round greenery

Figure 22 – Communal space with year-round greenery

Figure 21 – Communal space with year-round greenery

Figure 23 – Communal space with year-round greenery

2.2 Society

The private living spaces of the extension are divided into two sizes. This creates a good mix of small living spaces for different groups of people. The 78 square metre flat has three rooms and is suitable for three to four people. With 36.5 square metres, the smaller flat is about half the size of the larger one. It has two rooms and can be occupied by one to two people. On average, 21 square metres of private living space is available to each inhabitant of the extension. The private living space per person was about 25 square metres in 1970, and it has risen steadily in the following decades. In 2018, the figure was 46.7 square metres per person. We want to make a statement with our addition and make the small living space special through quality and efficiency.
The living spaces have an open floor plan to be able to respond flexibly to the needs of the users in the future. The openness is supported by the large window front on the southwest side. The optimal use of daylight creates a cosy room atmosphere. The result is a space for communication and retreat with an appealing view of the surroundings outside.

Our building should appeal to as many different people as possible and promote diversity in the neighbourhood. For this reason, all flats in the extension, all common rooms and roof terraces, as well as many of the existing flats, are accessible via a lift. All areas can also be accessed vertically via arcades at the level of the top floors, and the transitions into the building are designed without steps. The living areas are designed in such a way that they can be adapted to the needs of their users. This means that each flat can be used and occupied barrier-free without complications. It is important that future housing concepts include all groups of people and that there is the possibility to provide living space for different groups of people.

Figure 24 – minimized living space
The private living space in our building is minimized to the bare minimum. Instead, there are additional areas that can be used by all residents.

Figure 25 – common areas
Both inside and outside our addition of storeys are communal rooms with different uses. They are a place of rest and communication.

Figure 26 – accessibility
New lifts provide barrier-free access to parts of the existing building and all of the addition of storeys. All flats can be adapted to the needs of their residents.

Figure 27 – Group of Resident

To compensate for the reduced sizes of the floor plans, there are communal areas on each floor in our addition that can be used by all residents of the house. In addition, it is also intended to promote the togetherness of the entire neighbourhood and serve as a meeting place. They are always arranged near the staircases and are therefore easy to reach. The two floors are connected via atriums, creating visual axes and connections. To separate the surrounding flats from the noise of the common rooms, these can always be closed off by doors. Also, the wall thicknesses here are dimensioned higher to counteract the acoustics and avoid undesirable background noise.

The rooms serve as lounges and communication areas and are also intended to strengthen the sense of community and cohesion among the residents. Certain rooms can also be booked for private parties and leisure activities. There is also a fitness studio where equipment is available and people can take part in guided sports sessions. A café is also to be part of the concept to bring even more life into the building. Outside, the addition also offers open spaces for residents. There are roof terraces that can be actively used, especially in the summer months. These green areas can be optimally used for leisure activities and also for relaxation.

At the HDU, we show exemplary multiple uses of components. The BIPV façades on the south façade not only provide a technical component for regenerative electricity generation, but they are also the outermost façade shell, weather protection, and replace other façade cladding. PVT modules are used on the roof, which generates both regenerative electricity and regenerative heat or cooling on one surface.

Figure 28 – modular building structure
For a fast construction phase, we use prefabricated wooden modules for the living areas of the addition of storeys. These can be easily transported by truck.

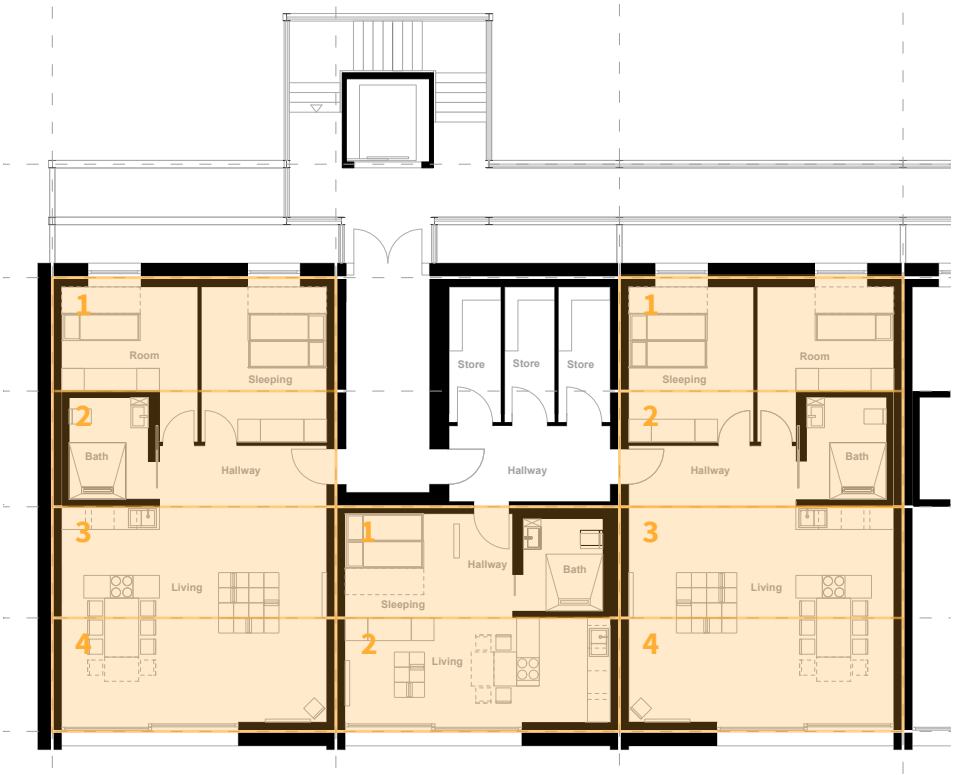


Figure 29 – Floor Plan Level 1 of the addition of storeys showing the module system

2.3 Climate

Increasing soil sealing is increasingly destroying the natural cycle of rainwater, especially in cities. The classic discharge into the sewage system often leads to an overload of the sewer network and the infrastructure of the sewage treatment plants during heavy rainfall events, which are becoming more frequent due to climate change. To avoid the above-mentioned problems and minimise costs for residents and the city, unpolluted water is decoupled and infiltrated in our project. The rainwater from the roofs and the overflow from the rainwater tanks, as well as the surplus water from the greywater from the greywater treatment plant, are channelled into a gravel pit, where the water is stored and can slowly seep away. At the same time, water reaches the top through lateral slits and the capillary effect of the soil. This effect leads to evaporative cooling, which is caused by the surface water and thus directly has a direct positive influence on the urban climate. In addition, the infiltration of further rainwater avoids surface runoff on the property.

To irrigate the biodiversity in a resource-saving way, the direct use of rainwater is an option. The collected rainwater is ideal for watering the plants, especially due to its low hardness. Since the rainwater is used exclusively for irrigation purposes and not for sanitary purposes, additional fine filtration is not necessary.[4] Short pipe runs and a low pumping capacity are ensured by the tanks being installed close to the consumer. In order not to endanger the statics, several small tanks are interconnected to form a battery on the upper floor of the annexe. In dry periods, the greywater system supplies the necessary water for irrigation. Rainwater is collected via a collector in the downpipe, which is flooded when the tanks are at maximum level. In the event of prolonged heavy rainfall, the excess water is infiltrated directly on-site using a tunnel trench.

The changing precipitation events and the decrease in the total amount of precipitation require the integration of alternative solutions such as the treatment of water that is not heavily polluted. In addition, increasing urbanisation poses a major challenge to the water supply. With a greywater treatment system, about one-third of the precious drinking water can be saved even in dry periods by supplying toilets and washing machines with service water. This makes this system worthwhile not only from an economic point of view but also from an ecological one. For this purpose, the slightly soiled water from the shower and washbasin is treated. To keep costs low, the systems are located on the ground floor of the extension building. This way, several neighbourhoods can share one treatment plant. If there is a surplus of service water, the rainwater tank can also be refilled due to its high quality.[5]

Figure 30 – rainwater harvesting
To irrigate the biodiversity in a resource-saving way, the direct use of rainwater is an option. Rainwater is ideally suited for watering plants.

Figure 31 – use of grey water
With a greywater treatment system, drinking water can also be saved during dry periods by supplying the toilet and washing maschine with service water.

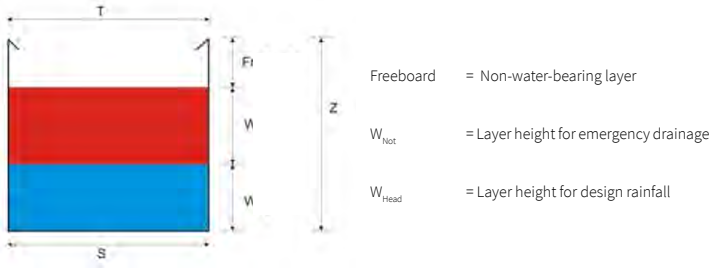


Figure 32 – dimensioning roof drainange

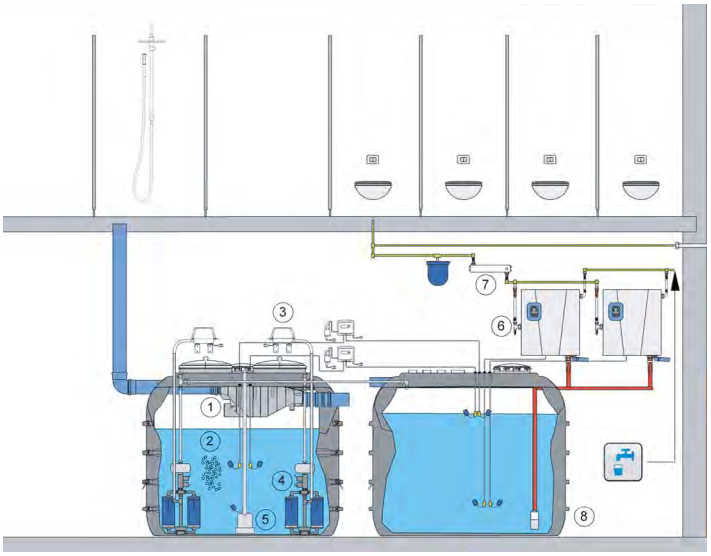


Figure 33 – greywater treatment

The interior gutters of the extension building have three gutter layers. The first is sized according to the calculation rainfall of the 5-year rain event. At the boundary with the layer above, there is a free-flowing emergency overflow at the top of the gutter. This layer can drain the century rain. Should strong winds occur in this layer, the freeboard prevents the water from overflowing. Should water nevertheless get over the edge of the gutter, the lower outer edge prevents it from penetrating the wall or roof structure.6,7 The terraces or flat roof areas of the building with closed parapets are equipped with additional emergency overflows for the century rain in addition to the normal drainage gutters. These are freely drained onto the property via a separate downpipe.[8]

The exterior walls of the existing building will be fitted with a facing façade as part of the renovation. To use the large thermal storage mass of the existing wall even more effectively, it is to be thermally activated. For this purpose, heating circuits will be installed between the existing wall and the new insulation level to provide low-energy temperature control. This means that the solid existing wall is no longer used solely to compensate for thermal peaks in the interior in summer, but that it is also possible to actively condition interior spaces in the existing building. In winter, for example, the basic thermal load of the rooms is covered by the façade activation, which means that the existing radiators with low flow temperatures can be used for individual temperature control. In summer, on the other hand, the nightly cooling capacity of the PVT collectors can be used to remove heat from the existing wall. If the wall is cooled down during summer nights, a cold reservoir is created indirectly, which can be discharged on hot days to cool down the storey above. More detailed information on this can be found in the Engineering and Construction report.

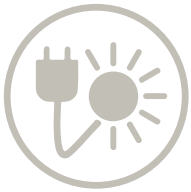


Figure 34 – energy generation
Most of the energy is generated on the roof, where more than 1000 m² of PVT modules are installed· The south facades are covered with a PV facade·

2.4 Durability

In construction, we use our knowledge of nodes from 2010 to ensure frequent transport, fast assembly times and materials that can be separated by material type.
We want to ensure the longest and most efficient use possible for our Design Challenge, so we explain below how it can be adapted to other uses if necessary. Our modules span themselves, which means that no internal walls are load-bearing. This allows variable floor plans to be implemented and adapted for different uses. The common rooms can also be divided into new spaces by zoning. With a uniform room height of 2.40 m, the building can meet many usage requirements.
The assembly and disassembly of our modules are quick and efficient, as they arrive on-site prefabricated and can be dismantled in the same way when necessary.
Our façade is covered with BIPV façade panels, these are mounted on a substructure and can be easily installed and also removed again. This is advantageous if measures to retrofit the façade are necessary for the future.
During the construction of the HDU, great importance is attached to ensuring that the pipes - electricity, water and air - are permanently accessible and enable damage-free maintenance and replacement. We need this principle for the very reason that we develop „levelup“ as a modular, fully pre-installed „plug & play“ system. We completely prefabricate our HDU in Rosenheim, bring it to Wuppertal in modules and then reassemble it for permanent subsequent use as a daycare centre and family office in Rosenheim. All cables must be easily accessible in the module and element joints and be able to be connected without damage. The cables are located either behind the removable wall, ceiling or floor coverings or in freely accessible ducts.
The entire electrical cabling runs e.g. in the skirting board. The cabling can be easily retrofitted or replaced at any time. Switches are radio-controlled, which means that no wiring is required in the wall. This means that we do not need an installation level in the HDU. The earthen building panels can be attached directly to the solid wood wall, which gives us a very high thermal mass despite the lightweight construction, which is very advantageous for thermal insulation in summer. Our bathroom is an absolute speciality. Here, all wall and floor coverings are mechanically fixed and quickly removable. This means that not only can the cladding itself be replaced without damage, but all the pipes are freely accessible and can be replaced with minimal time and expense.

Service products in the form of services with manufacturer take-back at the end of the life cycle also lead away from the linear economy towards the circular economy and motivate to think about new financing possibilities. In addition, we offer interested companies the opportunity to present their innovative products in the Solar Decathlon competition.
Also worth mentioning is the cooperation with new software for real-time life cycle analysis of buildings, which enables architects and planners to assess ecological and economic impacts already in the early design phase.

Figure 35 – Delivery of the wooden modules to the construction site

Figure 36 – Unloading the modules with a forklift

2.5 Building Materials

For the extension, we attach great importance to the use of sustainable, certified and regional woods. Wood is our primary building material. It can be mined, processed and used regionally, thus reducing CO2 emissions and the negative impact on our environment. The main construction used in our building is the timber module construction method. The modules are prefabricated in the region to avoid long transport routes and to save emissions. Due to the high degree of prefabrication, the construction time on the building site can be reduced and used more effectively. This also benefits the residents of the existing building. In addition, the modules are designed to exactly match the dimensions of a truck. The construction of the roof is also adapted to this size to avoid excess lengths and additional costs.
All superstructures correspond to standard timber cross-sections that can be reused for any timber construction after use. We use the shredded roof tiles from the existing building for the roof fill in the ceilings, thereby promoting a constant circular economy, saving disposal costs and providing a sustainable use for existing building components. In the extension, the roof tiles provide the necessary sound insulation within the building.

Both the two-storey extension and the renovation façade are predominantly made of wood, a lightweight construction material. The structure attached to the garden side for stairs, lifts, arcades and balconies is also made of lightweight steel. Apart from the interior cladding made of clay, heavy mineral building materials are completely dispensed with. Except for the necessary foundations, no concrete is used.
The interior walls are clad with clay building boards from Playtech. The clay building boards are 100 % recyclable or compostable at the end of their life cycle. The clay building boards will be plastered with clay. The ceilings are equipped as acoustic ceilings made of silver fir and sound-absorbing and moisture-regulating softwood fibre insulation. The flooring consists of regional ash parquet. All room-enclosing materials are therefore humidity-regulating and create a pleasant and even room climate.
The walls and floors of the bathrooms are clad with waterproof Resysta boards. There is no need for glueing at all, and the bathrooms can be recycled. Resysta consists of 60 % waste material (rice husks) and is 100 % recyclable.
In the interior, affordable sustainable chipboard is used for the furniture. The Swiss Krono Beyond boards consist of 100 % recycled wood, the binders are made of 97 % renewable bio-based raw materials and can be completely recycled. The chipboard can be recycled without any losses; the small mass proportion of the coating is thermally recycled.
Magna recycled glass is used as a worktop in the kitchen. This is recycled glass melted with reduced energy input. It can be completely recycled at the end of its life. Almost all the materials used are fully recyclable: wood, steel, glass, clay.
The floors are constructed as a floating, non-glued structure of mainly wood and clay. All materials we use are untreated and biocide-free.

Figure 37 – primary building material wood
We primarily use wood as a building material. This can be minded and processed regionally, thus reducing the negative impact on our environment.

Figure 38 – Wooden building material on our construction site

Figure 39 – Building our HDU

The interior walls are clad with pollutant-free clay building boards with clay plaster. The acoustic ceiling by Lignotrend with PUR glue is formaldehyde-free. The parquet flooring made of sustainable ash (PEFC) is virtually formaldehyde-free and Blue Angel certified. The emission value of the Beyond chipboard we use for our furniture is a maximum of 0.01 parts per million (ppm). This corresponds to only 12 millionths of a gram per cubic metre (µg/m3) and is well below all legal requirements worldwide. They meet the requirements (ZU-76) of the Blue Angel environmental label. The wooden walls are double-boarded with clay building boards and thus meet the fire protection requirements. The wooden ceiling is dimensioned for burn-off. This means that no fire protection coatings are required.

The ventilated façades have either an outer façade cladding of glass-glass, BIPV modules or oiled silver fir triple-layer boards fixed with wooden nails. There are no paints and no surfaces of the HDU are coated, neither the BIPV glass surfaces, the wooden facades nor the steel beams. The steel is hot-dip galvanised for durability and recyclability.
The flat roof is waterproofed with a permanent standing seam sheet covering and is bitumen-free. The roofs are made of standing seam sheet metal due to their durability, even with repeated assembly and disassembly. No copper or zinc is used.

Figure 40 – Fastening the clay building panels in the interior

Figure 41 – Clay plaster on the clay building boards

figures

40 Urban Mobility Report

Table of contents

1. District Level: City of Nuremberg

1.1 Topography

The central train station of Nuremberg is located 309 meters above sea level (MASL). While the lowest point, which is located in the Kleingründlach district on the northern edge of the city, (284 MASL), the highest point within the city ring is in Burgberg (352 MASL).

1.2 Transport connection

Nuremberg is located in the north of Bavaria and with its population of approximately 520,000 is the second largest city in Bavaria. Together with its direct neighbouring cities of Fürth, Erlangen, and Schwabach, the Nuremberg conurbation comprises of some 1.3 million people. Bus lines 30 and 33 connect the airport with Nuremberg's northwest.

The airport can be reached within twelve minutes by using subway line U2 from Nuremberg's central station. The central station is centrally located and is the only long-distance train station in Nuremberg. Long-distance trains offer direct connections to the Rhine-Main and Ruhr areas as well as to Stuttgart, Rostock, Hamburg, and Vienna, Austria. Nuremberg has good connections to the Autobahn (freeway) network. Three major German freeways, the A3, A6, and A9, intersect to the south-east of Nuremberg. In addition, the A73 provides Nuremberg with good connections to regional cities like Erlangen and Fürth. The freeways are easily accessible via the federal road network. Nuremberg also has a ring road called the federal highway 4R. This road completely encircles Nuremberg, and along with the federal roads B2, B4, and B8, is one of the most important main traffic junctions in Nuremberg.

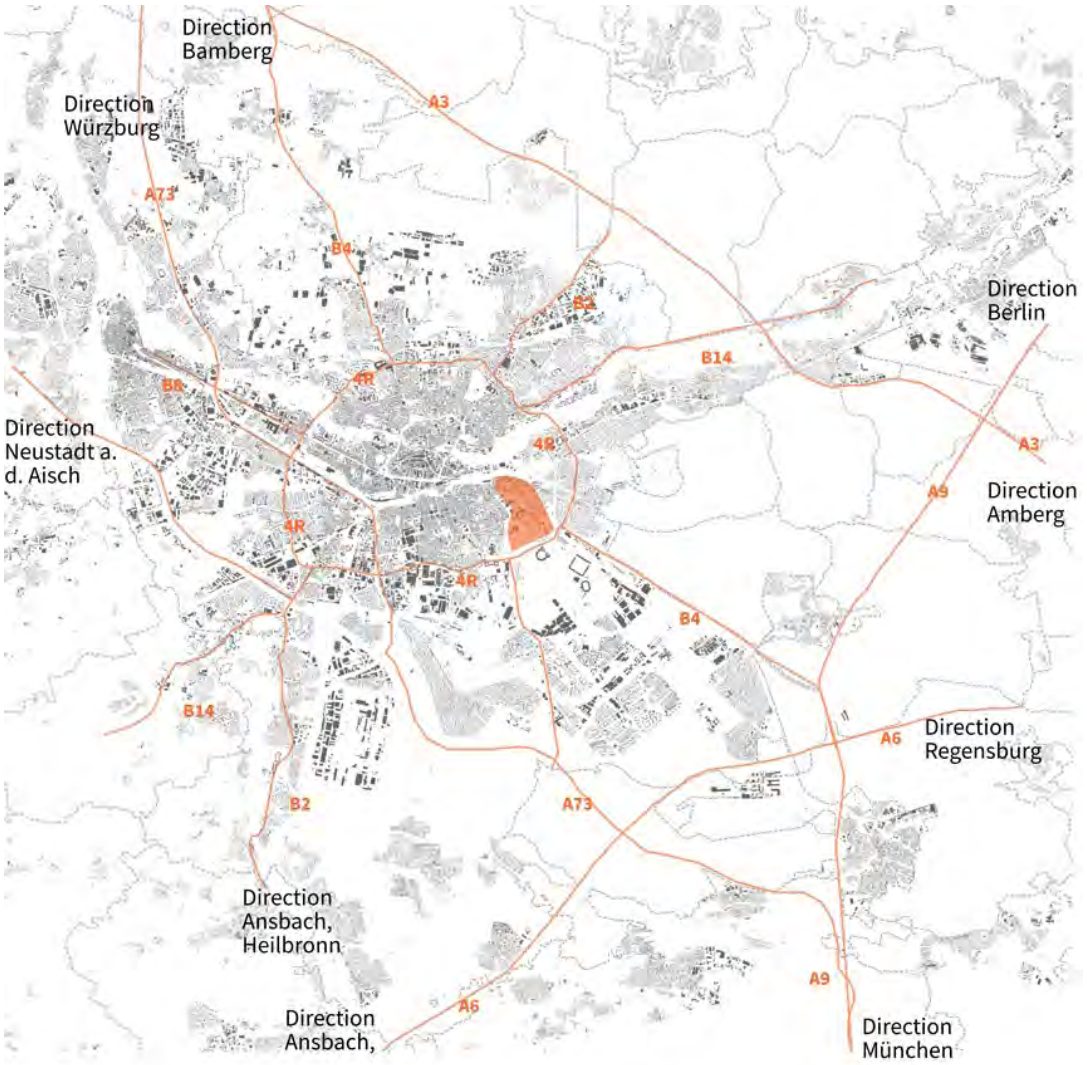


Figure 1 - Nuremberg road network

1.3 Waters

The Pegnitz is considered Nuremberg's city river and is part of the cityscape. The watercourse meanders through the metropolitan area. In comparison to earlier times, the Pegnitz was robbed of its natural river bed, diverted by man for use for the hydraulic structures of former mills. Prevented from its natural flow, this intervention has caused over one hundred floods throughout history.

1.4 Traffic characteristics

A recent survey of Nuremberg's residents commissioned by VAG showed that 76 % feel that road traffic is on the increase. As many as 89 % consider the associated consequences to be either „less bearable" or „no longer bearable". This puts traffic at the top of the list of municipal issues.

1.5 Main means of transport

The normal traffic route of the average Nuremberger is 19 km and 65 minutes per day. With 41 %, the automobile is the most used means of transportation. (Figure 3) This share is to be significantly reduced by the new mobility concept. However, for a total of 49 % of their journeys, Nurembergers already travel with an environmentally friendly alternative (bicycle, walking, public transport). Particularly striking in Nuremberg is the younger generation (18-23 years of age), because this group only uses automobiles at 27 % as a means of transportation. Comparatively, they tend to prefer environmentally friendly alternatives like walking, cycling, and public transport. At 46 % among the 45-64 age group, car use is highest of all age based groups in Nuremberg.

1.6 Motives for mobility

On average, 84 % of Nuremberg's residents leave their homes at least once a day. The reasons for leaving home vary, but they are an important indicator of mobility. The most common reasons are work, shopping, and leisure.

1.7 Commuters

In the Nuremberg region there are 223,316 employees subject to social insurance contributions. Of these, 71,715 (32.1 %) commute to work in another district (outgoing commuters) every working day. At the same time, 162,863 employees commute to the Nuremberg region (incoming commuters). The commuter balance thus amounts to +91,148, with the majority of commuters coming from the neighbouring cities of Fürth and Erlangen.

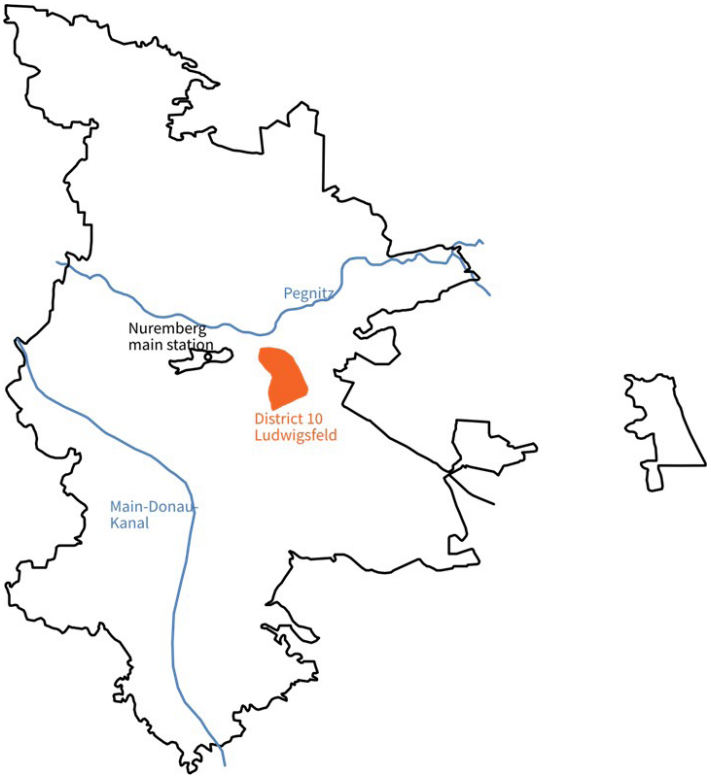


Figure 2 - Nuremberg City, Ludwigsfeld Marking

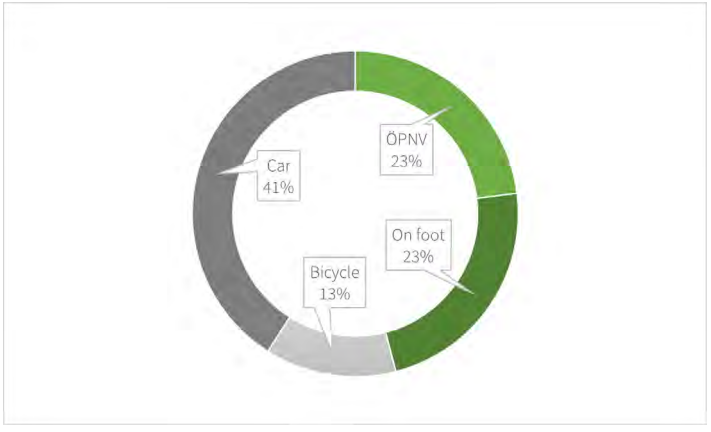


Figure 3 - Main means of transport

1.8 Decreasing means of transportation

In general, there has been an increase in bicycle traffic (+2 % since 2002) and a decline in the level of motorization (-3 %; 32 % since 2002). This is also expressed in the citizens' desire for greater political commitment to public transport, with the majority rejecting motorized individual transport. Children and young people in particular use public transportation, bicycle, or walk. This tendency, according to the Environmental Association, is increasing among young adults. For middle-aged individuals, the automobile plays a greater role. However, here too there is a change of thinking among the population. There are 475 cars per 1000 inhabitants. Old town Nuremberg offers 725 paid parking spaces (2.50€/1. hour city centre or 1.50-2€/1. hour parking garage) as well as 824 free parking spaces. Three out of five cars are moved daily, with only 1.3 persons in vehicle per trip. On average, 161,545 commuters commute to Nuremberg every day, with 67,039 of those from Nuremberg. In 2018, Nurembergers were stuck in traffic jams for an average of 119 hours. A subway with green electricity transports up to 600 people, which corresponds to 462 cars, 103 kg CO2, 215 g nitrogen oxide, and 2.3 km of congestion.

1.9 Sharing offers

More mobility with less traffic shall be made possible in the future, requiring a successively changing understanding of mobility among citizens: sharing, renting, borrowing instead of owning. This is where the MiFaZ, the online car-sharing agency of the Nuremberg metropolitan region offers much potential. Apart from the MiFaZ, which is free to use, there are also commercial sharing services. The largest car sharing provider is „Scouter" with over 80 vehicles. Scouter is a cooperation partner of VAG (Verkehrs- Aktiengesellschaft Nürnberg). The VAG itself also offers sharing bicycles („VAG Rad"), which are available at 20 locations in the city. The approximately 300 bicycles cost users 5 cents per minute.

2. District level: Ludwigsfeld

2.1 Topography

The district of Ludwigsfeld is 315 m above sea level and situated on relatively level terrain. While the relatively higher points (327 MASL) can be designated as public open spaces, such as Luitpoldhain, the highest point in the neighbourhood (336 MASL) is located at the headquarters of the German Federal Employment Agency (Bundesagentur für Arbeit).

2.2 Basic Information

The district of Ludwigsfeld is the 10th district of the 87 urban areas of Nuremberg. It is located in the southeast of the city of Nuremberg and is categorized as one of the southern city municipalities. Ludwigsfeld covers 1.46 km2 and is home to about 11,400 inhabitants.

2.3 Structures of the neighbourhood

Due to the separating effect of Regensburger Street and Schultheiss Boulevard, the urban division, which divides Ludwigsfeld into three sub-districts is very apparent. The northeast of the district, where the existing building is located, is connected to the densely populated settlement structures of the inner city sub-districts. The central zone is home to the Federal Employment Agency, which is also the geographical centre of the district. The southernmost area, on the other hand, is designated for public use, and green spaces open up the district towards Volkspark Dutzendteich to the south, the largest park in Nuremberg.

2.4 Points of interest

Shopping opportunities are plentiful in the centrally located neighbourhood of Ludwigsfeld. These are easily accessible by car or bicycle, which makes it easier to transport goods. Grocery and clothing stores are mainly located in the northern part of Ludwigsfeld, near Nuremberg's main train station. Smaller cafés and restaurants are also scattered throughout the northern part of the district, which offers more diversity for the residents. The Luitpoldhain is the place to enjoy nature and free time in Ludwigsfeld, because it consists of 21-hectares of public green space that offers a wide variety of leisure activities. In the north of Luitpoldhain is the Municipal Culture and Congress Centre of the city of Nuremberg, named the Meistersingerhalle.

Figure 4 - Uses in the neighbourhood

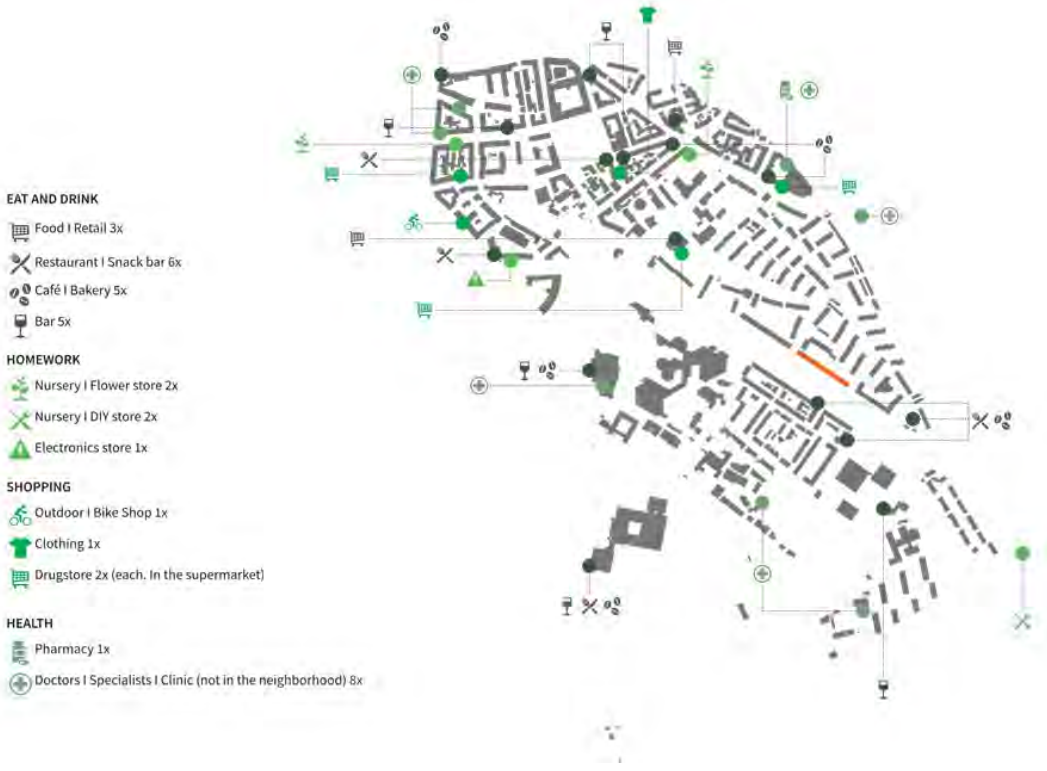


Figure 5 - Uses in the neighbourhood

Luitpoldhain is integrated into the local road network and can be reached by car and bicycle. Luitpoldhain is also home to the palazzo of star chef Alexander Herrmann, where both culinary arts and entertainment are offered. Since the district is mainly characterized by residential areas, there are a very limited number of companies providing employment. The two largest employers are the Federal Employment Agency and the Diehl Technology Group. Furthermore, there are several industrial enterprises, most of which are to be found in the automotive sector.

2.5 Social structure

Ludwigsfeld has a very heterogeneous population structure, with 31 % of the inhabitants having a migration background, and 70 % of the inhabitants between 15 and 64 years of age. The age structure in the district is changing to the effect that the average age of residents in higher age brackets is increasing, while those in younger age groups are stagnating or decreasing. In Ludwigsfeld, the 4,659 employees subject to social insurance contributions is 58 %. At 6 %, the unemployment rate is 1.8 % higher than that in the rest of the city. The number of buildings that house seven or more apartments classified as multi-family houses dominates the neighbourhood at 88 %. The purchasing power index of Nuremberg's residents was 104.2 in 2020, which is above the national average of 100. More precise information on the purchasing power of Ludwigsfeld's residents is not currently available.

2.6 Traffic characteristics

Ludwigsfeld is strategically and spatially well situated for access to public transportation (city bus, streetcar, and suburban train). The accompanying streetcar route on Regensburger Street offers two centrally located stops (Scharrer Street, Immelmann Street) for both residents and visitors to public parks and outdoor spaces. The suburban train line S2, with three stops, runs along the northeastern border of Ludwigsfeld. (Figure 6 and 7)

The central train station can be reached by public transportation in about 20 minutes. Bus lines 30 and 33 connect the airport with Nuremberg's Northwest. The airport can be reached via Nuremberg's central station in twelve minutes by subway line U2. The main train station is centrally located and is the only long-distance train station in Nuremberg. Long-distance trains offer direct connections to the Rhine-Main and Ruhr areas, as well as to Stuttgart, Rostock, Hamburg and Vienna, Austria. There are a total of 23 public stops in the neighbourhood, 11 for the city bus, 9 for the streetcar, 2 for the suburban train, and 1 station specifically for train connections.

During rush hour, the respective public transportation services run at moderate intervals to the central train station. The rush hours that are being referred to are as follows: Monday - Friday: 06:00 - 09:00 and 16:00 - 19:00 The city bus runs 6 times per hour in both timeframes, the streetcar 7 times in the morning and 6 times in the evening, the suburban train 3 times in the morning and 4 times in the evening, on average, with the train having only 1 timeslot in each timeframe. The neighbourhood is also connected to the main traffic axis, where state roads junction with the surrounding freeways. Ludwigsfeld is bordered on the south by Bayern Street (part of the Nuremberg's city ring B4R) and to the west by Münchener Street. This diverse network creates important traffic junctions and larger traffic hubs with concentration points for public transportation.

2.7 Bicycle grid

The bicycle grid within Ludwigsfeld sufficiently covers the area to reach all primary destinations such as grocery stores, leisure activities, and family doctors. Bicycle paths are available at the building complex on Regensburger Street and are integrated into the general road network. Most destinations within Ludwigsfeld can be reached by bicycle within 5-10 minutes. The bicycle grid offers a simple connection to the main train station, which can then be used to reach further destinations.

Figure 6 – Ludwigsfeld, Bicycle paths, e-charging and sharing points

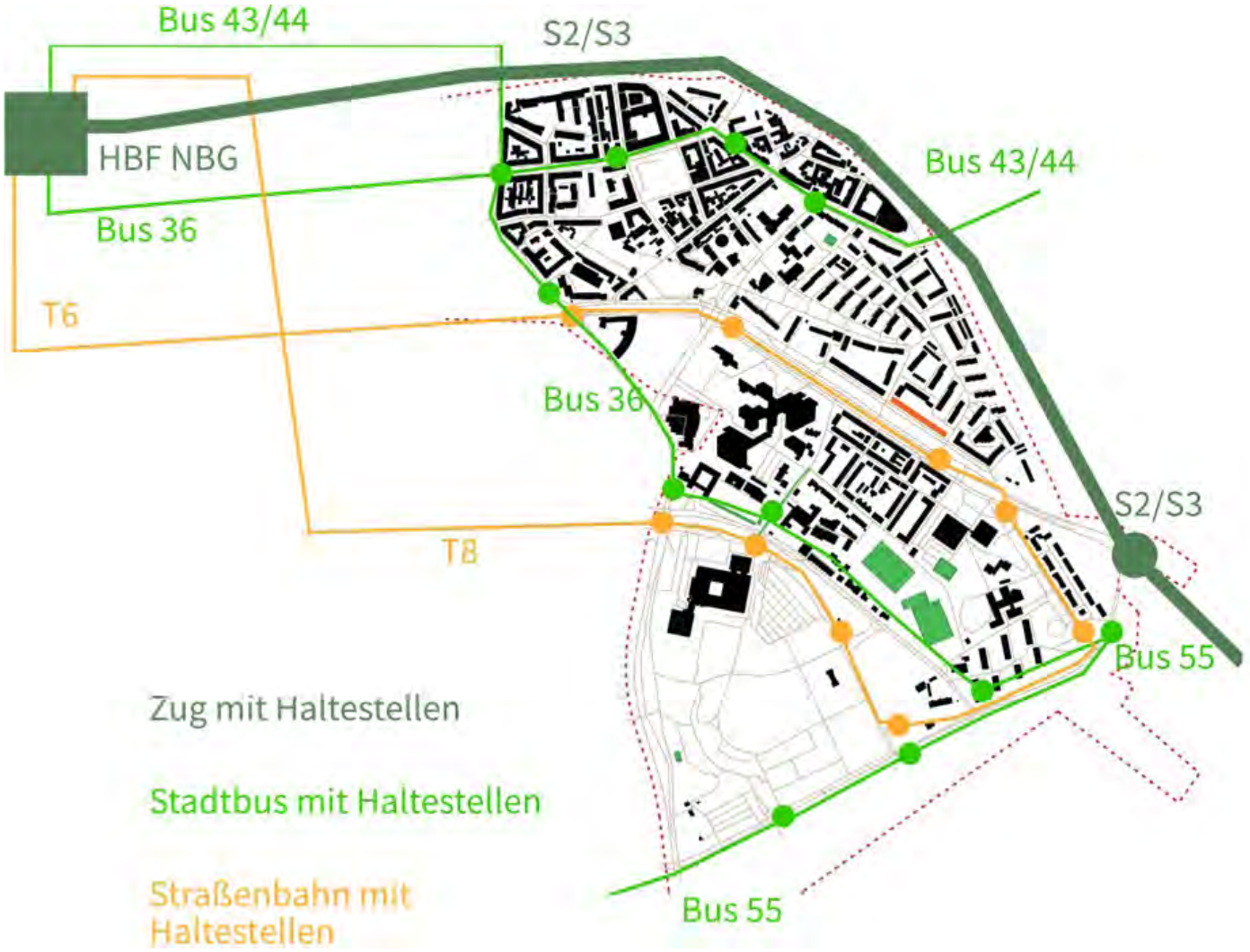


Figure 7 - Ludwigsfeld, Public stops

2.8 Parking

Except for roadside parking, public parking spaces can be mainly found in the south of Ludwigsfeld. These are located near the Federal Employment Agency as well as in the vicinity of the Dutzendteich student residence. Located near the Meistersinger Halle in Luitpoldhain, there are also two larger, paid parking lots with 200 and 650 parking spaces respectively. The parking facilities provide easy access to neighbouring districts such as Dutzendteich. (Parking in Nuremberg, City of Nuremberg)

2.9 Declining motorization level

A change in thinking can also be observed in the Ludwigsfeld district. Since 2014, the number of privately owned vehicles (POVs) registered in the district has been declining continuously. The total number fell from 361 to 337 cars per 1000 residents.

2.10 Offer of the Environmental Association

Two charging stations for electric vehicles are offered at the parking lot of the Luitpoldhain district park. Another station is located at the sports boarding school Sankt Paul – “Haus der Athleten”. These are charging stations with a charging capacity of 22 kW and plug type 2, which offers commuters and students an environmentally friendly way of charging their vehicles close to the site, and easy access to the nearby central train station. The car-sharing provider “Scouter” offers a station in northern Ludwigsfeld to provide a flexible alternative for residents of the neighbourhood, who only need a car now and then. Sharing concepts help relieve parking pressure in densely populated areas and offer mobility opportunities for socially disadvantaged people. Sharing points can be easily reached within a few minutes by foot or by bicycle.

3. Building level: Ludwigsfeld

3.1 Existing building

The existing building is located at Regensburger Street, numbers 143-159, and is located directly opposite to the Federal Employment Agency. Located very centrally in the neighbourhood, the building offers a good starting point to reach public transportation, the bicycle grid, as well as major traffic hubs.

3.2 Public transportation infrastructure

This central location also offers an extensive connection to the public transportation network of the city of Nuremberg. The streetcar stop can be reached in a few minutes at Scharrer Street north-west and Immelmann Street south-east. The bus stops at Bestelmeyer Street north and Peterskirche north-west are both about 600 m away, respectively. The Gleißhammer suburban train station is located 700 meters to the northeast. Nuremberg's central train station, which is about 3 km away and easily reachable by streetcar, bus, or bicycle, can also be used to reach further destinations.

Figure 8 - Infrastructure near the property

3.3 Parking

There are no designated parking spaces for residents, which belong to the building; however, roadside parking is permitted along the following routes: Regensburger Street, Parsberger Street, and Vellburger Street. It is unknown how many residents have their own cars, they are therefore dependent on nearby parking facilities. (Figure 8)

3.4 Social structure

There is no further detailed information about the social structure in the existing building. The social structure of the district can be used for this purpose.

3.5 General traffic situation environment stock

The existing building is located at 143-159 Regensburger Street and has nine (9) main entrances on the south-west side that access the apartment blocks. The north-east side of the building also has nine (9) rear-entries facing the backyard.

There are no permanently allocated parking spaces, which is why residents park on the hard shoulder (approx. 25 parking spaces) on Regensburger Strasse (30 zone).

- Parking garage: Neumarkter Street 59a in the immediate vicinity of the railroad tracks
- Parsberger Street: 30 zone, sidewalk without high curbs available, half of the cars park on the sidewalk
- Neumarkter Street: 30 zone, sidewalk without high curbs available, half of the cars park on the sidewalk
- Routes from existing building to the parking garage:
- By car: ca. 1 min, 400m
- By bicycle: ca. 1 min, 400m
- On foot: ca. 5 min, 300m

4. Mobility concept

4.1 General vision

The goal of the mobility concept is to provide incentives and opportunities for sustainable living and to promote interaction and a sense of community among residents. The sharing concept will eliminate the need for residents to own cars, reducing the number of cars per resident and providing various sustainable alternatives. Furthermore, carpools can be formed between residents, linking driving routes and thus significantly reducing traffic density and the number of cars on the road. In addition, the aim is to promote community and interaction among the residents. The concept is reflected in a specially developed „Sharing-App“ which promotes the previously explained goals using user-friendly functions. In order to achieve these goals, residents are to be analysed in terms of their social status (sinus milieus, age, marital status, etc.). Together with their mobility behaviour, this information is necessary to optimally tailor the sharing concept as well as the app to future users. Accessibility, cost and availability of vehicles in the sharing pool must optimally meet the needs of the residents for the concept to be successful.

4.2 Target group

The current tenants, who can be assigned to the ten Sinus Milieu, have been mainly assigned to the ‘class grouping’ of traditional and lower-middle class. First, the ‘traditional milieu’ is represented, and is characterized by anti-individualistic thinking, social forms and moral concepts. There are also residents who are classified in the ‘precarious milieu’. The middle-class grouping, who affirm the social order and strive for professional and social establishment as well as secure harmonious relationships, are also represented. It can be assumed that future residents will strive for a different basic orientation and can be classified as belonging to a somewhat higher stratum. ‘Adaptive-navigators’ are the determined, mobile young middle-class of society, who are success-oriented, willing to compromise and have a strong need for flexibility and security. Likewise, there are also residents who can be assigned to the ‘hedonistic milieu’.

They are generally characterized by the fact that they live in the “here and now” and belong to a fun-oriented, modern lower-class or lower-middle-class and accordingly have little control and planning. The ‘socio-ecological’ may become future residents, who have idealistic, consumption-conscious views and are globalization sceptics. They are characterized primarily by a pronounced ecological and social conscience.

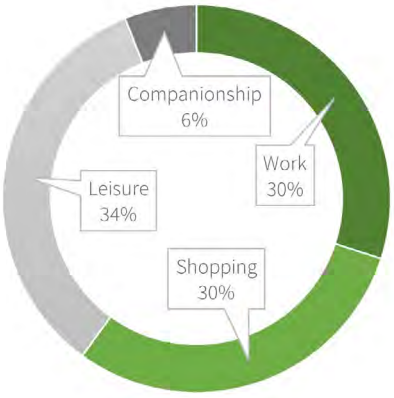


Figure 9 - Motivations for mobility

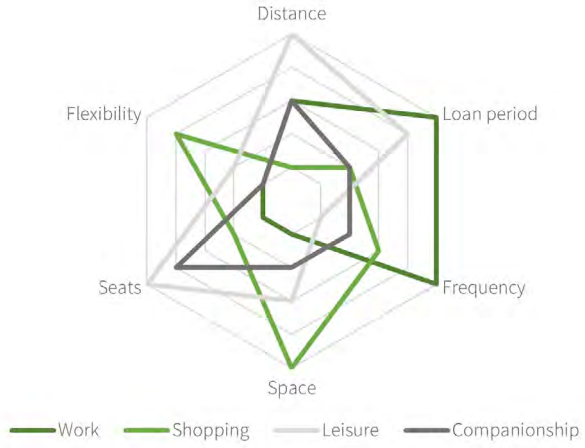


Figure 10 - Vehicle requirements

		Renault Zoe	VW ID3	Mercedes EQA	Falter C 4.0	Fischer Cita 6.0i	Fischer Leo 1.0	Prophete Cargo 3R
Needs	Shopping							
	Leisure							
	Companionship							
Age	Young							
	Old							
Budget	Low							
	Medium							
Lifestyle	Traditional							
	Modern							
Expected Use		High	High	Low	High	High	Medium	Medium

Figure 11 - Sharing-pool requirements

Principally, the picture among the residents is rather heterogeneous. When it comes to different age groups and family status, everything is represented in the existing building. Therefore, it is clear that the concept must be suitable for a broad target group. The selection of a suitable vehicle pool particularly comes to the fore here, as this is where different needs are most relevant. This selection process is explained elsewhere in this document.

4.3 Mobility offer

As described in chapter 1.6 and shown in figure 9, the motivations of the people of Nuremberg can be broken down into the four categories of work, shopping, leisure, and companionship. These motivations result in vehicle requirements that must be fulfilled to support them in the best possible way. Figure 10 describes the extent to which certain requirements must be present for each activity. As an example, for the activity „shopping“, the storage space of the vehicle is particularly important, whereas the range (distance) is not as important, because Ludwigsfeld offers numerous closely located shopping opportunities.

The analysis shows that vehicle sharing is less suitable for the activity „work“, because a vehicle is needed that is available to a person in high frequency and duration. This not only contradicts the sharing idea, but also cannot be reconciled with the stationary concept (vehicles always must be returned to the car park of the existing building). However, the concept should also offer a solution to this fraction of the target group.

The app offers the function to form carpools in order to compensate (Chapter 4.5.4) for this last issue. In addition, a discounted job ticket is to be offered through cooperation between housing providers and public transportation authorities to discourage residents from using privately owned vehicles.

Considering previous information and available resident data, there are ultimately four criteria that were considered in the vehicle selection. These are the needs (motives), the age of the residents, the existing ability to pay (lower/middle class) and the lifestyle of the residents (milieu). The vehicles were chosen to fully cover the range of these criteria (Figure 11) and comparatively estimates the ratio of vehicles needed. For example, less Mercedes EQAs are needed than VW ID3s, as they can significantly meet more needs of the residents. Nevertheless, the EQA is a good addition to the fleet as it is more suitable for larger purchases, transport, or family trips, etc.

Part of this needs assessment is used to identify necessary additional equipment for the fleet in order to provide the maximum benefit to the residents. The additional equipment is included in the price of vehicle use for the residents. For motor vehicles, the following equipment is to be included in the vehicle: Dog transport boxes, child seats, navigation systems and, automatic opening tailgates. For bicycles, users will benefit from bicycle helmets, locks, mobile phone holders, transport trailers, child trailers, child seats, saddle bags, bicycle baskets, air pumps, and spare batteries.

4.4 Public transport

In addition to the vehicle sharing offer, the public transportation offer is to be better adjusted to the residents' needs. Two criteria play a decisive role: firstly, the frequency of departures, which indicates at what minute intervals the means of transport depart from a station and are thus available to the residents, and secondly, the distance to the nearest station where the means of transport is available. Since residents can reach public transportation in the vicinity on foot, the distance from this point is measured in „Walking minutes“.

The green dots in the matrix of figure 12 represent the current availability of bus, tram, and suburban train stops in Ludwigsfeld. For each line or mode of transport, the closest station to the existing building was selected. The X-axis indicates how far the station of the respective means of transport is from the existing building. The Y-axis shows the frequency with which the means of transport depart from a given point. The exact location of the stations can be seen on the map in figure 7.

From this actual state, a target state has been developed that specifies a suitable distance and departure frequency for each means of transport. This ideal condition is shown by the red dots and black arrows in figure 12. The arrows indicate what improvements in distance and frequency certain modes require (e.g. down arrow means higher departure frequency desired). The red dots are the associated recommendation to achieve this. In the following, the means of transport have been analysed and recommendations for improvements have been made.

Bus: Lines 43 and 44 currently run every 10 minutes. Since they depart from Gleißhammer train station 5 minutes staggered, commuters can take a bus every 5 minutes direction city centre (Hauptbahnhof). The distance is a 7-minute walk. However, to do e.g., the weekly shopping within Ludwigsfeld, the route is time-consuming, as one could also walk directly to the supermarket in a number of minutes. An additional bus route along Regensburger Street would solve this problem. If the bus stopped at the Immelmann Street tram station, the expected distance would only be a 2-minute walk. In addition, to make the way home at night shorter, and above all safer, the night bus N3 should run every half hour instead of every hour, and also stop at a bus stop on Regensburger Street. The residents will benefit from a safer walk along a busy and well-lit Regensburger Street to their homes, not having to cross the entire district.

Suburban train ("S-Bahn"): Currently, the S2 departs from Gleißhammer station every 20 minutes, and the S3 also runs on this line, but only stops at very selected times. A simple solution to double the frequency of the S-Bahn is therefore to have the S3 stop at Gleißhammer every 20 minutes and 10 minutes staggered to the S2, resulting in an S-Bahn to the main station every 10 minutes.
Streetcar: Since residents already have access to two different streetcar lines within a 3-minute and a 10-minute walk, there is no need to expand these services as the 10 minute frequency is satisfactory.

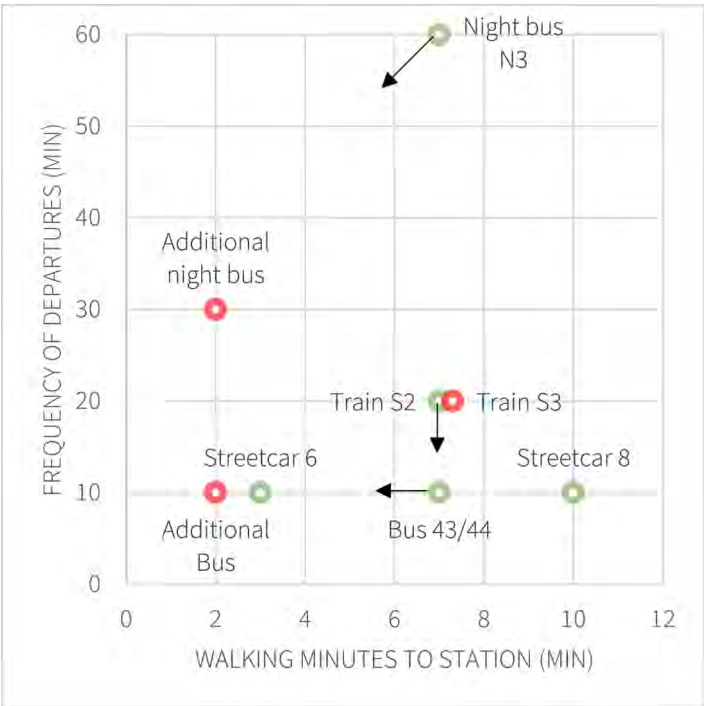


Figure 12 – Public transport actual and target state

Public transport offers, whether in planning or to be expanded, are directly linked to changes that affect private transportation, which tends to be a delicate matter. On the one hand, residents who are dependent on private vehicles, e.g. for work reasons, should be enabled to use these sensibly. On the other hand, there are measures that are intended to restrict privately-owned vehicles in order to relieve traffic congestion and make public transport more attractive. Current nation-wide measures include or are being debated: excluding cars without a green environmental badge from city centres, establishing a general 30 km/h speed limit within urban areas, designating parking spaces for electric vehicles, and increasing fuel taxes. Likewise, similar measures are being considered in the Ludwigsfeld district that should lead to a change in mind set among residents.

The planned multi-storey car park (Chapter 4.7) should ease the parking situation for the residents of the existing building, because they will no longer have to rely on finding parking spaces along the street. Furthermore, the multi-storey car park is designed with sustainable mobility in mind with the inclusion of charging columns and bicycle parking spaces.

Providing residents with an incentive to use electric vehicles, parking spaces along Regensburger Street, notably in front of the existing building, have been designated as free-of-charge but 'electric vehicles only' parking spaces.

Although a Park & Ride car park is not a sensible solution in Ludwigsfeld, the neighbouring area around the Dutzendteich offers great potential due to the trade fair car park and the fairgrounds. Because both offer extensive parking facilities and are well connected to public transportation, an area is to be made available free of charge to commuters and residents, which is expected to curb traffic density in the city centre.

The residential, break-away street directly in front of the existing building, which happens to be named Regensburger Street, has already been designated a speed-restricted area. The multi-laned, two-away transit street also named Regensburger Street, runs parallel to this and is separated by a approx. 30 meter wide verge strip. Reducing noise pollution for residents and providing further incentives to switch to public transport could be accomplished with further speed limit reductions from 50 to 30 km/h.

Finally, in order to reach people who do not want to give up their own vehicle, the introduction of carpool-only lanes is an effective measure.

4.5 Mobility app

4.5.1 Framework

Current residents of the existing building and future tenants alike should benefit from a firmly established sharing concept, which can be easily used via an app. This will motivate the exchange of goods and services among the residents. In this context, a sharing concept for bicycles and cars is to be implemented, which will be booked via the app and billed using a points system. The offer is not only intended to support residents who do not own vehicles, but also to encourage residents to refrain from owning a vehicle.
The app follows a non-profit principle in order to counteract misappropriation and to ensure that the idea of social togetherness is not lost through commercial endeavours. The app is financed by income (rental of vehicles from the sharing pool) to cover costs such as insurance of vehicles and bikes and the maintenance work of the app. Surpluses that arise at the end of a period are reinvested and the prices for the user are accordingly adjusted.

The currency used by the app consists of so-called “points”. These points can be earned by renting your own goods, or by completing various services. Points can also be purchased in the app by bank transfer, but they cannot be cashed out again.

Common in the industry, the development of the app is controlled by agile project management (SCRUM). In a first step, all requirements (”Features”) for the web application are listed by means of user story mapping. (Figure 13). Horizontally the features are clustered in so called “Epics” which represent certain thematic focuses or functions. Vertically the features are sorted by their release date. The highest prioritised contents are in the MVP (Minimum Viable Product). It is imperative that this content be included in the app to enable the testing and evaluation of the core functionality. Less important features belong to the first release and features which are nice-to-have, but not crucial, to the second release. As soon as all requirements are listed in the map, their functionality is specified. This includes the definition of “User stories”. They specify the requirements for the development team from a user’s perspective, and make it easier to check whether goals have been achieved. All features that have already been implemented, as well as those that are planned, can be found with their detailed user stories in the appendix. Finally, the relationships between the different functionalities are presented either by means of BPMN (Business Process Model and Notation) or wireframes within a clickable prototype. This allows the visual requirements of the app to be better communicated to the development team.

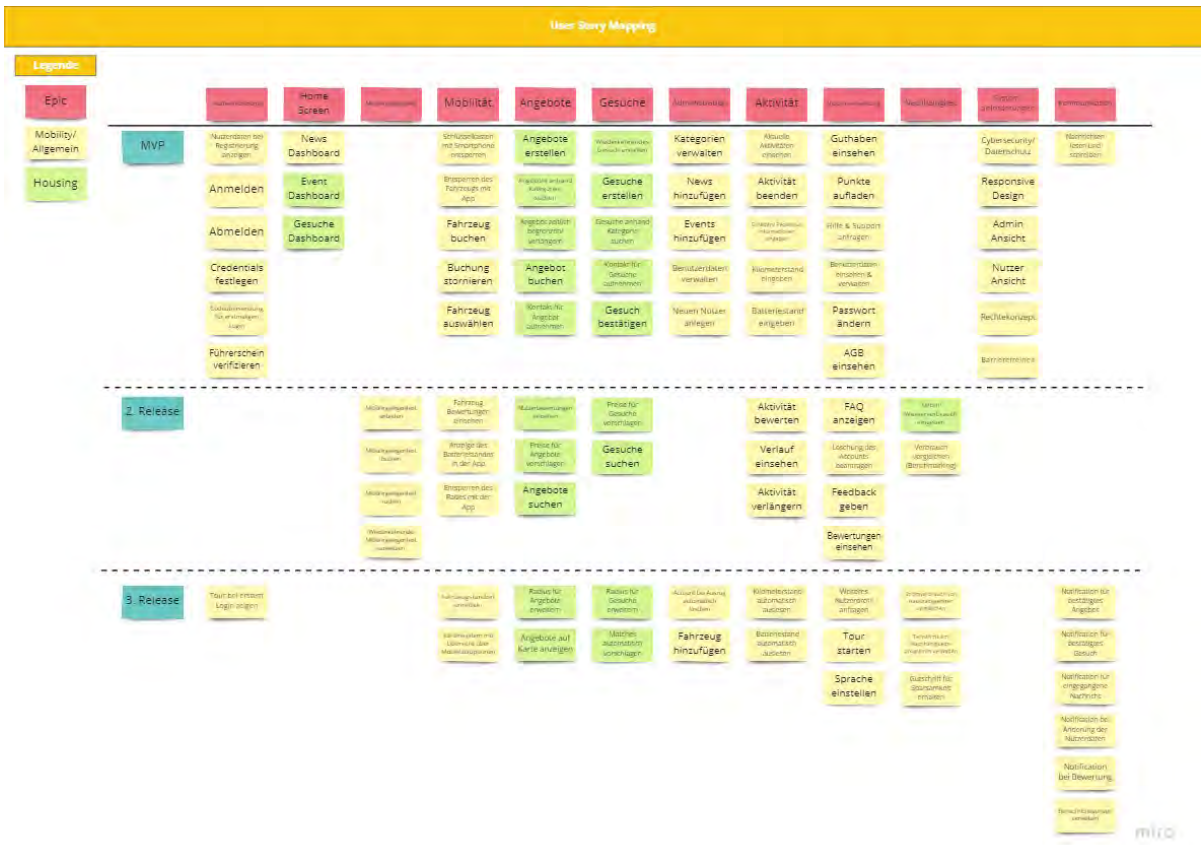


Figure 13 – User story mapping

4.5.2 Point system

The distribution of points is explained below. To make the conversion of real money into points transparent and easy to understand, 1 point corresponds to 1 cent. This should make it easier to calculate and convert actual service, barter, or loan transactions.

The prices for products and services are set among the residents. As far as vehicle rentals are concerned, the cost of bicycles is determined by the time system, whereas distance and time determine the price of the rental period for cars. Leased e-cars are provided by a certain quota of driven kilometres (for more information on profitability, see the Viability report).

Vehicle	Points/km	Points/min
Renault Zoe	19	3
VW ID 3	23	3
Mercedes EQA	29	4
Bicycle Falter	0	1
E-Bike Fischer	0	2
Cargo bike Fischer	0	2
Load triad Prophete	0	2

Table 1 – Point System

4.5.3 Core functionality (MVP)

One of the overriding goals of designing a cell phone app are to facilitate the exchange and interaction of residents in Ludwigsfeld. This will be accomplished by means of a simple, user-friendly interface, in order to make the app assessable even to people not experienced with similar technology. Furthermore, the integration of a sharing concept remains one of our top priorities, and will help to reduce the average number of cars per capita, and thus CO2 emissions.

The app is divided into five sections: home, mobility, offers, requests, and activity. Please refer to the appendix for the technical implementation of the app.

Home page: The home page lists news, future events, and current requests from fellow residents. Via the user profile, points can be topped up using various payment systems. Furthermore, personal data can be viewed, as well as the history of past activities. In addition, the users' language can be changed or push notifications can be activated or deactivated under settings options. Contact details of the apartment superintendent and the administrator are provided. Residents can also chat with other tenants using a chat function.

Mobility: The process of renting a vehicle is as follows: first, a means of transport is chosen (car, bike, e-bike, cargo bike). Then, using the data provided, the exact type of any given selection is selected. Under „Book time slot" a popup with a calendar system opens, and a time slot is chosen. The free time slot can be booked (highlighted in the calendar) and then confirmed.

Example: a family wants to rent a car for a trip, for which they choose the VW ID 3. The family is on the road for a total of 2 hours and 16 minutes, they drive a distance of 21 kilometres. (see Figure 14)

Offers: In this area, items or services can be offered among the residents. For example, if someone owns a cordless screwdriver, they can post it in the app and share it with other residents. To do this, go to „Create offer", select a category (in this case „Tools"), enter a short description (possibly with a picture) as well as a price suggestion and your own contact details. Offers run for one month, and can be extended as often as desired. If someone wants to use one of the offered items or services, the category is chosen first, then the exact type is determined. After this, one books the time slot analogous and makes an appointment with the respective tenant.

Example: Markus owns a toolbox, which he is willing to offer in the sharing app for 2 points per minute. Another resident is interested and rents the toolbox for three hours. On the same day, Markus goes on a bike tour with one of the bikes from the sharing pool. He is on the road for five hours but still gains 60 points at the end of the day because of the loan of his toolbox. (see Figure 15)

Requests: In addition to the „Offers" function, „Requests" gives residents the opportunity to search specifically for items or services. For example, an elderly woman requires shopping assistance. To do this, she goes to „Create wanted ad" and enters all the needed data (analogous to „Offers"). If someone is interested in assisting her, the woman's ad can be found under „Services". The person can now contact the woman by using her contact details provided, and in this way pre-finance the loan of items or services they require.

Example: An elderly woman has placed her want ad for a shopping assistant and a message. Shortly afterwards, student Lena agrees to this, and they settle on a price of 300 points. She borrows a cargo bike for the shopping, with this she wants to transport a grill to friends later. The rental time is five hours. This results in a price of 600 points. (see Figure 16)

Accounting family	
Price for distance	- 483 P (23 P / km)
Price for duration	- 408 P (3 P / min)
Total	**- 891 P**

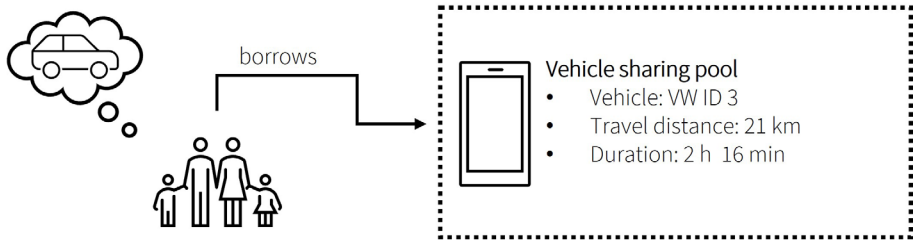


Figure 14 - Example borrow

Accounting for single person	
Bicycle rental	- 300 P (1 P / min)
Toolbox loan	+ 360 P (2 P / min)
Total	**+ 60 P**

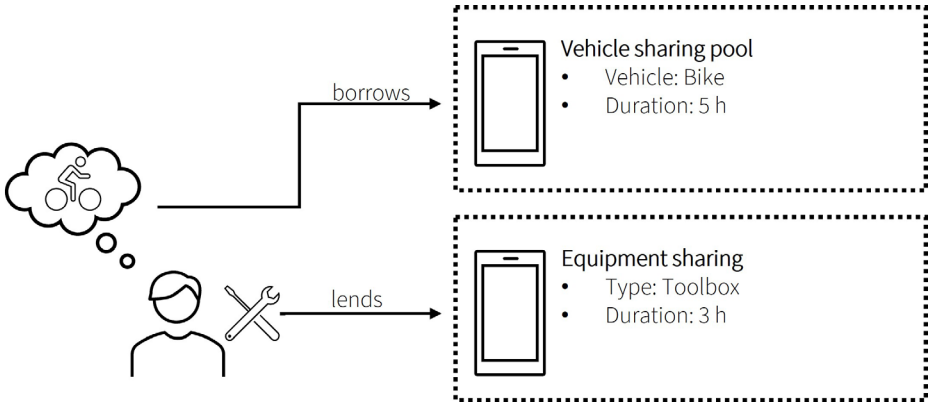
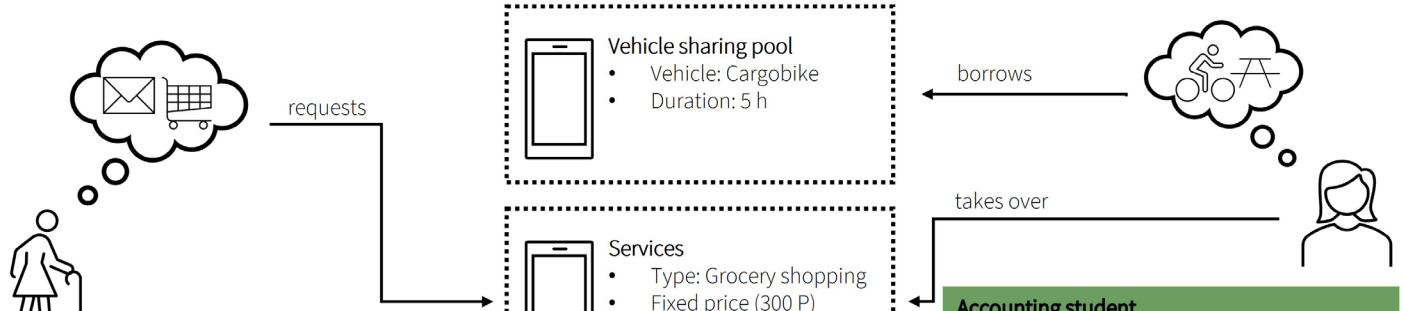


Figure 15 - Example use services



Accounting elderly lady	
Shopping & Mail	- 300 P
Total	**- 300 P**

Accounting student	
Shopping & Mail	+ 300 P
Cargo bike rental	- 600 P (2 P / min)
Total	**- 300 P**

Figure 16 - Example of a service

4.5.4 Extended functionality (Releases)

In addition to the core functionality described above, which primarily enables the lending and borrowing of goods and services, the app is intended to offer users far more in-depth functions in the long term. These are described categorically below and are also listed in the user stories in the appendix. The core functions also separate the actual app from the long-term conception. The extended functionality thus describes functions that are currently not yet implemented in the app but are to follow in the releases. If the implementation is not possible due to limited resources, they will still be transferred into a clickable prototype.

Authentication

When a new resident moves in, an access code is to be automatically generated for the app based on the master data recorded by the property management, as well as a username according to a defined scheme. Both will be provided to the resident by email (or post). When the user logs in for the first time, he or she can determine a new password, check the stored personal data for correctness and adjust it if necessary. From this point, the user can log in with their „credentials“ in the app or in the web browser. To ensure that the resident is authorised to rent vehicles, their driving licence is checked by the property management and the expiry date is stored. Should the user unexpectedly have to surrender his driving licence, they are required to inform the property management immediately.

Access

Since the app is programmed as a web application, it is possible to access the content via smartphone as well as via computer. However, since the target group also includes older people, it must be assumed that not every user has internet access. For this purpose, a tablet PC is to be installed in the entrance area of the existing building as well as in the parking garage to enable all residents to access the sharing app. Users can log in with their credentials and use the app. An enclosed click guide allows users to easily get started using the app. In addition, after each new login, the app asks the user if they need a „guided tour“ of the app. This jumps through the various functions and provides information necessary for successful use. In order to make the access possible for illiterate or disabled persons, a voice control is implemented in the app. This allows one to navigate through the user interface by giving simple voice commands. Of course, this simplifies access for the standard user as well, who can quickly navigate to the desired content with commands such as „Is someone in my house renting a drill?“ or „Is there a car available at 4 p.m. today?“. Furthermore, there is the option to switch between different languages. For the time being, the focus is on German and English.

Mobility

The implementation of a map system in the app helps users to find the most suitable mobility options. The vehicles from the sharing pool as well as the local public transport are considered. Figure 17 shows conceptually how the content is conveyed to the user. By selecting a mode of transport (here train), surrounding stations are marked on the map. By clicking on the marker, the resident receives information on the distance and frequency of departures.

Figure 17 - Wireframe integrated map system

After successfully booking a vehicle from the sharing pool, the user can unlock the respective vehicle with the sharing app. The central locking system of cars and the spoke locks of bicycles can be unlocked in this way. In addition, all battery-powered vehicles transmit their battery and kilometre status to the app in regular cycles, which enables users to determine whether a vehicle is sufficiently charged for a certain distance or rental period. Moreover, the app can tell users to connect a vehicle to the charging station after returning it, and the administration can keep an eye on user behaviour in order to better adapt the sharing pool to the residents' needs in the long term.

Even if a respectful handling of the sharing pool is assumed, it is necessary to take preventive measures in the app to enable all users to access the vehicles equally. Users should therefore be able to cancel their trip free of charge up to two hours before the start of the trip. After that, a cancellation fee will apply. Users will also have to pay „penalty points" for late returns. As soon as a user has paid penalty points three times, he or she will be blocked from booking vehicles for one week. On the one hand, this ensures that no vehicles are booked even though they are not needed. On the other hand, users make sure to return their vehicle to the car park that it is available and on time for the next user. The calculation of penalty points and the automatic blocking of users will be carried out automatically by the app.

The formation of carpools forms a separate sub-function. Resident A, who drives to work in his own vehicle, can enter his daily destination and the radius along his route in which he is willing to drop off people. Conversely, if resident B is looking for a ride, he can enter the location of his work. The app checks whether the location is along resident A's route. If this is the case, the app shows Resident B the applicable option and allows him to contact the driver. Billing is done via the points system and can be automated in fixed cycles, e.g. three times a week.

Offers and requests:

For both offers and requests there is the function of recurring advertising. This means that a person who needs someone to do the shopping for them every Monday has to create the request only once by choosing in which frequency the request is to appear again. The same applies to billing. As described earlier for carpool participation, automated billing can also be used for the fulfilment of services or the regular lending of goods. If an exchange fails to take place once, the billing of points can be suspended.

Since the app is primarily intended to promote community identity among residents, and is not intended for the financial enrichment of individuals, there are categorical cost recommendations for goods and services. This means that while each resident can set a price for their goods to lend out, this price should be based on general guidelines. For example, as soon as a resident wants to offer a drill, the app shows him a „fair price recommendation" based on collected historical data for what price per hour he should set the drill at its maximum. This ensures that all residents offer their goods and services within a fair framework.

Requests are prioritised in the app. A request that has been posted for some time but has not yet been answered or is about to expire will therefore automatically appear at the top of the list. However, residents should also be able to prioritise their requests themselves. If, for example, a person urgently needs someone to fetch medication for them from the pharmacy and sets the appropriate priority, the request will appear at the top of the list. Users are able to choose whether to be notified by push notification if a resident posts an urgent request.

Another feature that is envisaged is the automatic matching of offers and requests. For example, if a resident creates a request for a drill, the app checks whether the keyword „drill" already appears in an offer. If this is the case, the app notifies the user and allows them to jump directly to the offer to check whether it meets his/her requirements. This function simplifies the exchange and ensures that there are no redundant offers and requests.

Once the concept has been successfully implemented in the existing building, the app can be rolled out to the entire Ludwigsfeld district. This has the great advantage that residents can access an extended search offer at district level. For example, if a desired tool is not available in the existing building, the availability of the entire district can be queried with one click. Offers are then displayed on a map in a similar way as with the mobility sector, allowing the user to choose the nearest offer outside their own building complex.

Other extensions

The residents can document their electricity and water consumption in the app. If smart meters are used, this could even be fully automated. The app shows the respective resident at which time he/she has the highest consumption and documents the values in a timeline.
The electricity cost calculator is related to this and should help to raise consumer awareness concerning electricity consumption. Household consumers can enter appliances, equipment and devices operated in their home into the app. The app then searches for fact sheets / consumption data of the items from the internet and shows the resident what their biggest „electricity guzzlers" are in the form of a pie chart. It then provides the resident with tips on how to reduce their consumption. A good example is a tumble dryer, which consumes about 3.2 kWh per drying period, which at an electricity price of 30 cents is equivalent to almost one euro.

The reward system that was developed for the app is based on obtained consumption data, and with the consent of the respective residents, the average consumption per person can be determined. Consumption is divided into three categories: CO2 consumption based on vehicles used, water consumption and electricity consumption. Every month, the residents with the lowest consumption, in a given category, receive a reward. This could be, for example, a free ride in a sharing pool vehicle. The aim is to motivate residents to think and act sustainably.

4.6 Advantages and benefits

The concept developed for the existing building and the Ludwigsfeld district brings numerous benefits. At the top of the list is to provide residents with extensive, and at the same time sustainable, access to mobility options. The offered sharing pool, combined with an enlarged public transport offer, will help to reduce car congestion in the city. Using Nuremberg's car density average of 41 cars per 100 residents as the basis for the calculation of the existing building with 400 residents, 164 people own a private vehicle in the building. With its 33 cars, the sharing offer is scaled and tailored to the needs of the residents in such a way that none of the residents is dependent on a privately owned car. This results in a potential saving of 133 cars in the existing building alone, and thus reduces the car density per 100 residents from 41 cars to 8.25 cars.

The price comparison with commercial sharing providers shows that the in-house sharing pool has economic potential. Figures 18 and 19 depict two possible sharing scenarios. In both cases, the prices are compared with the car sharing provider „Share Now" and the bike sharing provider „MVG Rad". Since all vehicles are rented to residents at cost price, in both scenarios, the commercial providers cost more than twice as much as the sharing pool we are presenting.

Figure 18 - Rental price for 2 hours 16 minutes and 21 kilometres distance

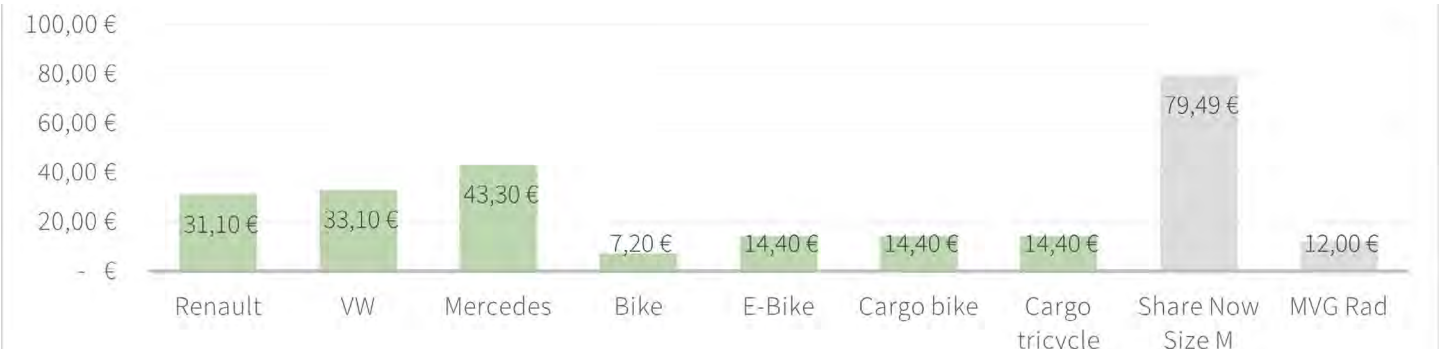


Figure 19 - Rental price for 12 hours and 50 kilometres distance

The sharing and mobility app forms the foundation of the concept, because it combines a wide range of functions that give residents access to modern and sustainable mobility options. The app's advantages are expressed as follows:

- Tailored to the needs of current and future residents
- Uncomplicated activation and initial registration
- Suitable for all ages (barrier-free, multilingual, in-app guidance and instruction)
- Playful teaching of a sustainable and communal way of life
- Access to the sharing offer in the app, on the web or in the entrance area of the existing building
- Offering/booking of goods and services with a few clicks at fair prices
- Direct communication with the building management
- Non-commercial
- Prices are significantly lower than commercial providers
- Fully automated rental and return of sharing vehicles
- Automatic billing
- Self-financed through income of the sharing pool
- Additional equipment for every application
- Holistic mobility solution: integration of public transport, sharing pool, and carpools
- Integrated map system
- High scaling potential at district and city level
- Incidental cost evaluation, electricity calculator and tips on sustainable action
- Bonus system

4.7 Parking garage - multifunctional garage for residents

A new parking garage is currently being planned in Ludwigsfeld. This is to be built on an area that is currently used as a garage yard and is located at Neumarkter Street 59a, directly on the railroad line. The site is located about 200 meters north-east of the existing building. This parking garage is to become an elementary component of our mobility concept for the existing building, as it will become both the main parking location for all our vehicles resources as well as the main charging station for the electric resources. The immediate proximity to the existing building is of great advantage, because it can be reached comfortably and quickly on foot.

4.7.1 Concept data

The parking garage is to become a building that does not only serve one purpose. Combining all added-value: parking, communication, and leisure in one place, the parking garage becomes an active centre that breathes life into the community with its endless offer. This will counteract the fact that residents of the existing building do not have access to residential parking spaces, and that existing parking facilities around the building are severely limited. Increasing the height of buildings not only means more living space in a given area, but also more cars and bicycles. Of course, we want to counteract this to some extent with the help of car sharing and our mobility concept, but mobilization cannot be completely eliminated. Parking spaces available in the parking garage offer added value for residents, because those who share a car are allowed to park in the garage at a reduced rate. This makes the use of car sharing even more attractive and saves valuable space. Residents who share an electric car are allowed to park in the parking garage free of charge. Furthermore, a sharing pool of electric cars and bicycles will be made available (see sharing concept).

The goal, in addition to the mentioned reasons for a multi-purpose parking garage, is to aesthetically enhance the district while promoting a place for gathering, communication, and community. Parking garages are often loveless colossi that do not fit into the overall image of a neighbourhood and tend to be perceived visually as a disruptive factor. The planned parking garage, on the other hand, is intended to enhance the neighbourhood and offer added value to the surrounding residents. This can be achieved by a green common area planned on the roof as well as workshops for cars and bicycles.

The first floor houses a workshop for car repairs, and is accessible from the outside as well as from the inside. An additional workshop and storage facilities for bicycles and accessories are also planned, as well as barrier-free toilets. Charging columns for cars and bicycles of all kinds are included and the possibility of retrofitting additional charging columns in the future is guaranteed. Parking spaces for families, senior citizens, and handicapped accessible parking spaces are provided on the first floor. The upper floors are accessible via car ramps. Two staircase cores with elevators are committed to the necessary escape routes, and a barrier free development of the entire parking garage is guaranteed. On the roof, there are green areas with sufficient seating facilities. The electricity for charging columns and lighting is partly generated by integrated PV surfaces.

Figure 20 - Garage yard existing situation

Figure 21 - Garage yard existing situation

Figure 22 - Site plan: Addition and neighbourhood garage

4.7.2 Floor plans and construction

Ground floor plan (Figure 23):

- 13 x car parking spaces (charging columns can be retrofitted).
- 4 x handicapped accessible parking spaces
- 3 x car parking spaces with charging columns
- 20 x bicycle parking spaces (+ charging stations)

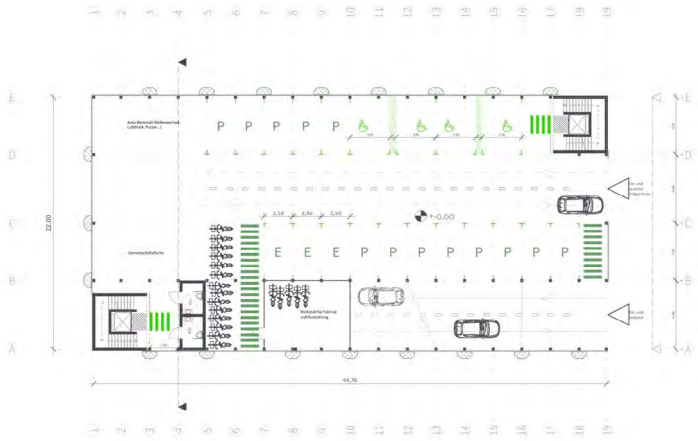


Figure 23 - Ground floor plan

1st - 3rd - floors (Figure 24):

- 26 x car parking spaces / (1-3)floors - in total: 78 parking spaces (preferred variant with roof garden)

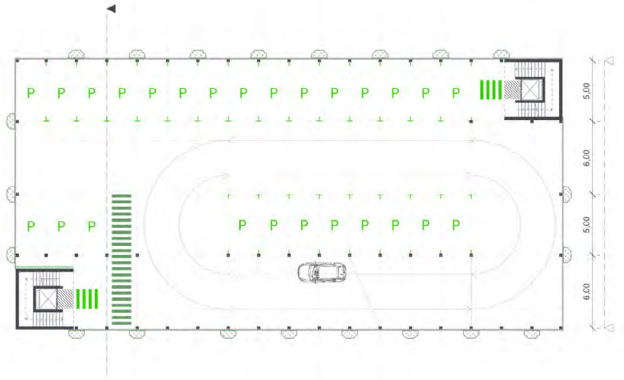


Figure 24 - 1st - 3rd floors

Roof-top garden (Figure 25):

- Green common areas to spend time and meet (read, barbecue...)
- Rainwater infiltration
- 253.5 m^2 PV area (charging columns car/bicycle/lighting)

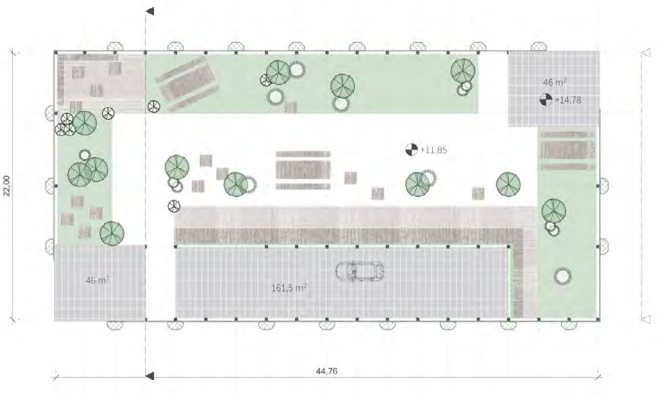


Figure 25 – Roof-top garden

The façade consists of a lamellar façade made of larch, and resembles the planned elevation of levelup's addition to stories. The parking garage's façade is fully recyclable and is connected with steel dowels and screws. The primary structure consists of laminated beech veneer lumber and precast reinforced concrete elements for the floors/ceilings.

The system, which was developed by Pollmeier Massivholz GmbH & Co.KG in conjunction with the Technical University of Munich (TUMWood), allows the parking garage to be expanded and reduces maintenance or costs for renovation measures.

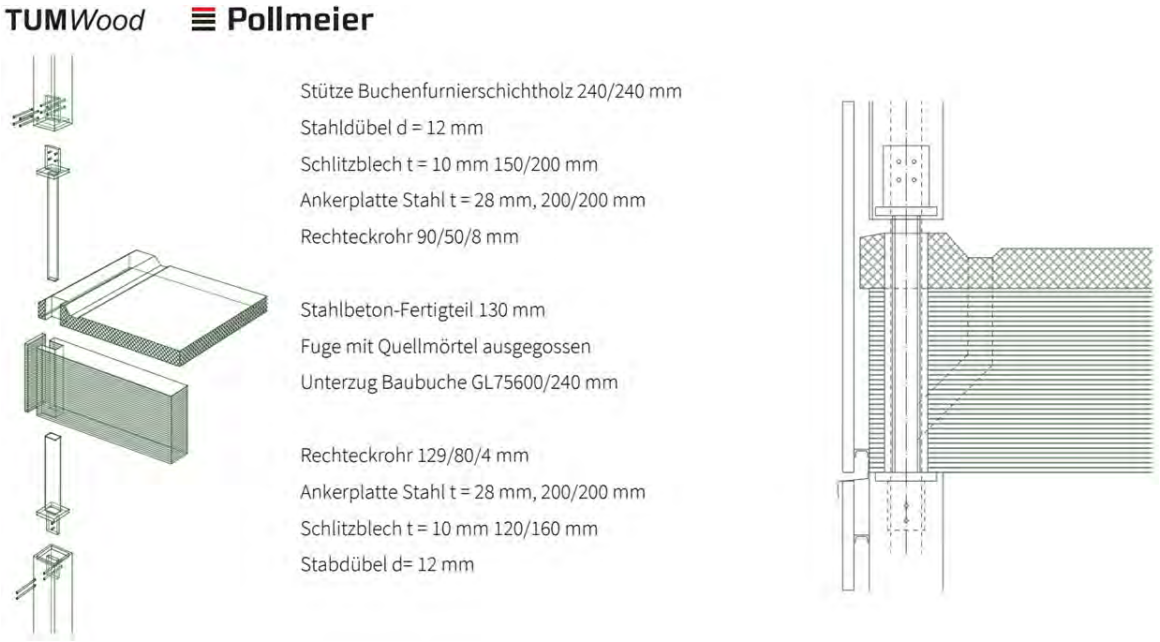


Figure 26 - Detail construction neighbourhood garage

Figure 27 - View and section

Figure 28 - View southwest

Figure 29 - Elevator and staircase

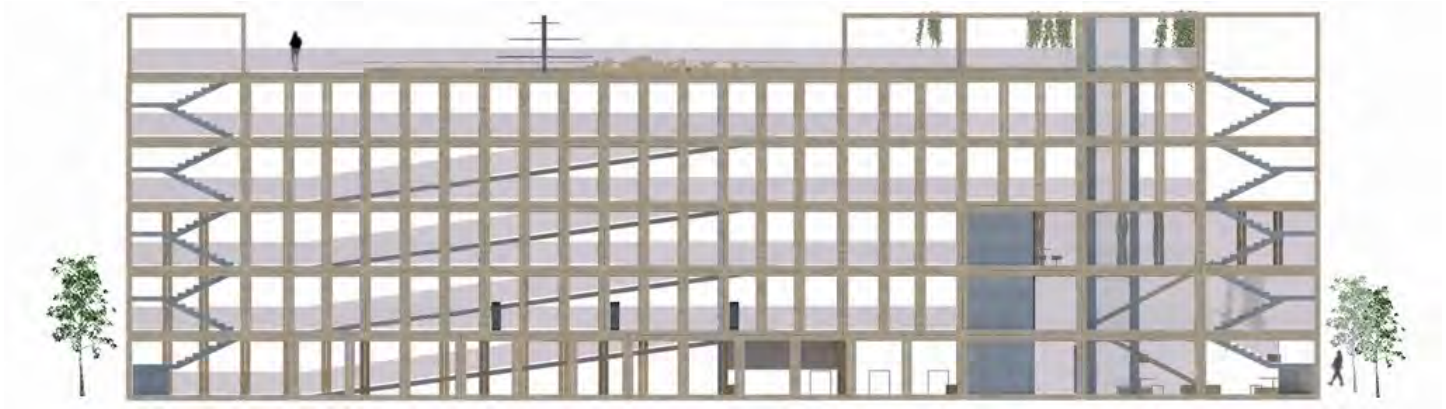


Figure 30 - View north

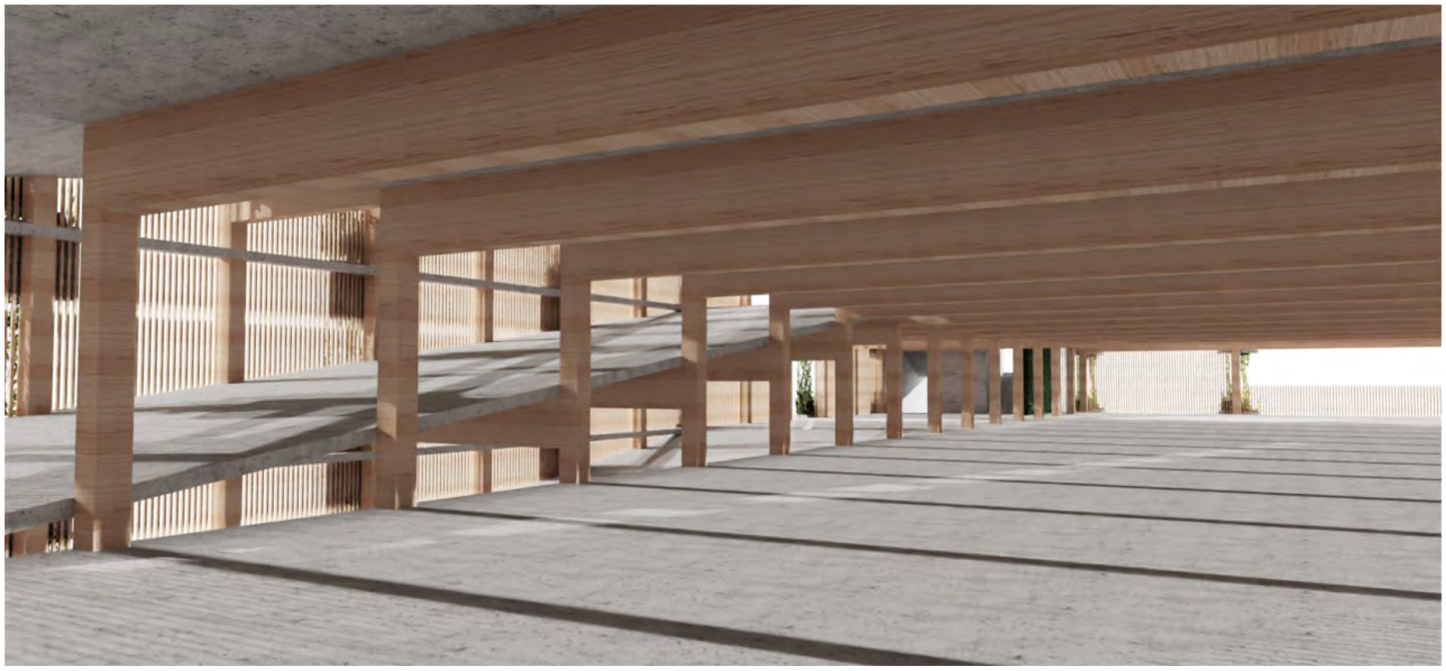


Figure 31 - Driveway and ramp

5. Implementation in the HDU

Since the sharing concept can be completely depicted by the app, it serves as the obvious choice to use as the primary medium for the presentation at the HDU. A distinction is made between the actual app, which depicts the current state of events, and a clickable 'prototype', which embodies the long-term goal of the app. The latter can be called up via a QR code and can be tested on mobile devices by visitors to the HDU. Guests can see what the different features will look like, how they will simplify the lives of the residents and enable a more sustainable living. In this way, visitors can click their way through the entire range of functions and thus through the entire mobility concept. They can, for example, virtually book the cargo bike that is parked and loaded at the HDU by using the app.Calling up the QR code leads visitors directly to the home screen of the mobility and sharing app. However, visitors will be able to choose between the German or English version in advance. Figure 32 shows the home screen from which users can start exploring the app.

In addition to the digital content, print media is used to provide visitors with information about the mobility concept. In particular, an information board is planned for the designed multi-storey car park. Floor plans and 3D images will be displayed here, which would otherwise be too difficult to recognise on a smartphone display. The same applies to district planning. In order to clearly describe how the district is supposed to change in terms of parking facilities, speed limits, private and public mobility, imagery will be displayed on posters. Furthermore, the benefits of the sharing concept are to be presented visually. In particular, the expected savings that can be achieved through the sharing offer, which are mainly private cars that are no longer needed due to the sharing pool and the incentive system for public transport. Car reductions are accompanied by a considerable CO2 saving, which is compared to CO2 emissions from other locations. Presentations aim at putting our project data into relation, so that visitors can understand the interrelations at a glance.

All described information concerning Urban Mobility will be placed inside the HDU as part of the public tour. This means that all content on Urban Mobility is presented in one central location along the tour.

One physical way to communicate sustainable mobility to visitors is by using the cargo bike. If the location allows, visitors should not only be able to book the cargo bike with the app, but be able to borrow it for a short test ride.

During the competition, the cargo bike is located directly at the HDU (Figure 33 and 34) and can be charged there via the associated power supply unit. However, it must be pointed out that this location is not representative of the actual situation in the existing building. After all, the HDU is an addition of storey to the existing building, which is why no parking spaces for vehicles of any kind are logically provided at this location.

Therefore, the parking spaces are to be found in the parking garage that was specially planned for this purpose (Chapter 4.7). Accordingly, there are 20 parking spaces for bicycles and cargo bikes, including charging stations. As a result, the parking spaces are all covered and easily accessible for the residents of the existing building.

Figure 32 - Mobility and sharing app home screen

Figure 33 – HDU cargo bike parking space

Figure 34 – HDU cargo bike parking space

figures

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41 Dinner Party Menu

Table of contents

1. Recipes Team levelup – ROS

Menu 1

Variation of pretzels & spreads [a, c, g, j, k, 2]

6 piece	Pretzels
6 piece	Pretzel sticks

Obazda

300 g	Cheese, Brie & Camembert
45 g	Butter
3 tbsp	Onions, very finely diced
3 tbsp	Sour cream
2 tsp.	Paprika powder
3 Pinch	Pepper
½ tsp.	Salt
1 ½ pinch	Caraway, ground
1 tsp.	Mustard, medium hot
50 ml	White beer

Mash all the ingredients on a plate and mix together.

Radish - Cress Spread

3 – 4 tbsp. (ca. 10g)	Cress
80 g	Radish
200 g	Cream cheese
¼ tsp.	Salt
¼ tsp.	Pepper

Chop the cress and radish with a blender.
Mix the rest of the ingredients with it.

Tomato spread

200 g	Cream cheese
6 Piece	Dried tomatoes preserved in oil
4 - 6	Basil leaves
1 tbsp.	Olive oil
1 tbsp.	Balsamic vinegar
1 Pinch	Pepper
1 Pinch	Salt

Chop the tomatoes and basil and mix everything together.

Tris of dumpling with sage butter - served with mixed salad

a, c, g, h, j, l, 3, 5, 6, 7, 8

Bread dumplings

12	Stale bread rolls
6 tbsp.	Parsley, chopped
20 g	Butter
500 ml	Milk
6	Eggs
1 Pinch	Salt and pepper
2	Onions, finely chopped

Cut the bread into small cubes.
Briefly sauté chopped parsley and onions in butter until colourless and mix with bread cubes.
Heat the milk until just before boiling and pour over the bread cubes. Leave to soak for about 10 minutes.
Whisk eggs with salt and pepper, add and mix everything into a not too firm dough.
Cook the dumplings in a pressure cooker until firm.

Spinach dumplings

12 (600 g)	Stale bread rolls
500 ml	Milk
1,5 kg	Spinach
60 g	Butter
2	Onion
4	Eggs
1 Pinch	Salt and pepper
2 tbsp.	Flour
4 tbsp.	breadcrumbs
2 Toes	Garlic
1 Toes	Nutmeg

Boil the spinach in salted water, squeeze and strain.
Soak the bread cubes in milk.
Fry the onion cubes and garlic in butter until colourless.
Add spinach and steam for about 5 minutes.
Mix the cooled spinach, eggs and bread, season with salt and pepper and nutmeg. Add flour and breadcrumbs and form dumplings from the mixture.
Cook in a pressure cooker until firm.

Beetroot dumplings

200 g	Beetroot (pre-cooked)
4 tbsp.	Butter
8	Shallots
5 (250 g)	stale bread rolls
4	Eggs
1 bundle	Parsley
1	Garlic clove
2 tbsp.	Flour
2 Pinch	Salt
2 Pinch	Pepper
4 tbsp.	Cheese

Peel the shallots and fry in butter together with the bread cubes until colourless. Finely chop the parsley.
Cut the beetroot into small cubes, mash with the eggs and cheese and mix with the shallot and butter mixture.
Add parsley, flour, salt and pepper and mix well.
Cook the dumplings in a steamer until firm.

Sage butter

500 g	Butter
6 tbsp.	Sage, fresh, chopped
120 g	Parmesan, grated

Chop sage and stir into melted butter.
Pour butter and Parmesan over dumplings.

Mixed Salad

2	Peppers
6	Tomatoes
1	Cucumber
1	Lettuce head
4 tsp.	Mustard, hot
4	Shallots
8 tbsp.	Balsamic vinegar, white
12 tbsp.	Olive oil
2 tsp.	Salt
4 tsp.	Sugar
4 tsp.	Mustard, sweet
20 tbsp.	Water
4 tsp.	Vegetable stock powder
A little	Salt & pepper

Cut the vegetables, mix the spices and shallots and pour over the salad.

Strawberry dumplings

500 g	Quark
140 g	Flour
140 g	Semolina
140 g + 60 g	Butter, melted
2	Eggs
24	Strawberries
1,6 kg	Breadcrumbs
800 g	Sugar
100 g	Icing sugar

Mix the quark, egg and melted butter together and then add the flour and semolina. Leave to rest for 1 - 2 hours.
Take some dough in moistened hands, flatten, place a strawberry on top and cover with the dough. The layer should not be too thin. Reshape dumplings with flour until they no longer stick.
Steam the dumplings in a steamer.
In a pan, toast the breadcrumbs in a little butter until golden brown and season with sugar. Roll the dumplings in it.

Menu 2

Vinegar dumplings Carpaccio & Radish Carpaccio [a, c, g, j, l, 5, 8]

Vinegar dumplings Carpaccio

6	Bread dumplings
1	Onion
1 bundle	Chives
5 tbsp.	Olive oil
4 tbsp.	Vinegar, balsamic vinegar
A little	Salt and pepper

Slice the dumplings thinly, lay them out on a plate and sprinkle with the remaining ingredients.

Radish Carpaccio

½	Radish
60 g	Parmesan
1 bundle	Chives
8 tbsp.	Olive oil
A little	Salt and pepper

Thinly slice the radish, lay out on a plate and sprinkle with the remaining ingredients.

Potato pancakes sweet and savoury, served with mixed salad

[a, c, d, g, j, l, 3, 5, 6, 8]

Potato pancakes

24	Potatoes, large
6	Onions
16 tbsp.	Flour
4	Eggs
A little	Salt and pepper
A little	Oil
375 g	our cream
1 bunch	Herbs (chives, basil, parsley)
A little	Salt and pepper
2 packs	Smoked salmon
1	Cucumber
1-2	Creamed horseradish from a jar
1	Applesauce from a jar
250 g	Mayonnaise
150 g	Sour cream
150 g	Sour cream
3	Garlic clove

Grate the peeled potatoes with a grater, season with salt and a little pepper. Add the eggs and diced onions. Dust with enough flour to cover the potato mixture. Mix everything together.
Fry the potato patties in oil and drain with kitchen paper.
Mix sour cream with herbs, salt and pepper for the herb dip.
For salmon on cucumber straw, cut the cucumber into fine strips, top with horseradish and salmon.
Mix the mayonnaise, sour cream, sour cream, 1 tbsp horseradish, herbs, garlic with salt and pepper for the garlic dip.

Mixed salad

2	Peppers
6	Tomatoes
1	Cucumber
1	Lettuce head
4 tsp.	Mustard, hot
4	Shallots
8 tbsp.	Balsamic vinegar, white
12 tbsp.	Olive oil
2 tsp.	Salt
4 tsp.	Sugar
4 tsp.	Mustard, sweet
20 tbsp.	Water
4 tsp.	Salt & pepper
A little	Vegetable stock powder

Cut the vegetables, mix the spices and shallots and pour over the salad.

Bavarian cream [c, g]

600 ml	Milk
2	Vanilla pods
10 Sheet	Gelatine, white
8	Egg yolk
200 g	Sugar
600 g	Cream

Whip the cream until stiff and place the gelatine, leaf by leaf, in the cold water. Pour the milk into a saucepan. Split the sides of the vanilla pods and add the pulp to the milk. Also add the pods for the time being. Heat the milk with the vanilla pod. Next, whisk the egg yolks and sugar until the mixture is white and creamy. The sugar must be completely dissolved.

Now remove the vanilla pod from the milk. Stir the milk into the egg mixture in a bowl. Whisk over a bain-marie of low heat. Remove the gelatine from the water, squeeze it out and gradually dissolve it into the cream while stirring. Then allow the mixture to cool and stir until it gels. Fold in the stiffly whipped cream shortly before. Cover the cream and refrigerate for a few hours.

Source: www.Lecker.de

Menu 3

Tomato gazpacho with toasted brown bread [a, j, l, 5, 6]

500 g	Beef tomatoes
500 g	Vine tomatoes
50 g	White bread
30 g	Vinegar
60 g	Olive oil
200 g	Paprika, red
1	Cucumber
½	Onion
1	Garlic cloves
2 tbsp.	Salt
1 tbsp.	Sugar
6 Slices	Black bread

Grind all ingredients in a good blender. Fry the brown bread in a pan and pour over the soup.

Celery escalope on white wine – beetroot – mirror with dumplings, served with mixed salad [a, c, g, i, l, 2, 3, 4, 5, 6, 8]

Celery escalope on white wine - beetroot - mirror

1 (1,2 kg)	Celeriac
4	Eggs
100 g	Breadcrumbs
8 tbsp.	Flour
12 tbsp.	oil
A little	Salt
1 bundle	Ground coriander
6	Beetroot, pre-cooked
3 tbsp.	Flour
70 g	Butter
2	Onions
	Beetroot juice from the pack
	Celery stock
1	Garlic clove
Two shots	White wine, dry
1 cup	Cream
4	Bay leaves
1 tsp.	Sugar
1 bundle	Parsley, chopped
1 tsp.	Creamed horseradish
1 cup	Vegetable stock

Peel the celery, wash, halve and cut into 5 mm slices. Alternatively, cut out patterns from the slices using biscuit shapes. Cook the celery in the pressure cooker for 2 ½ minutes. Beat eggs, mix sesame seeds with breadcrumbs. Season the celery with salt and ground coriander. Dredge in flour, egg and sesame mixture in turn. Fry the cutlets in oil.

Fry onions and garlic in oil until colourless. Add flour (25 g per litre of sauce), white wine, vegetable stock, cream and celery stock. Bring the mixture to the boil and season with bay leaf, salt, pepper and sugar. Cut cooked beetroot into cubes and boil down. Sprinkle with chopped fresh parsley.

Bread dumplings

12	Stale bread rolls
6 tbsp.	Parsley, chopped
20 g	Butter
500 ml	Milk
6	Eggs
1 Pinch	Salt and pepper
2	Onions, finely chopped

Cut the bread into small cubes.

Briefly sauté chopped parsley and onions in butter until colourless and mix with bread cubes.

Heat the milk until just before boiling and pour over the bread cubes. Leave to soak for about 10 minutes.

Whisk eggs with salt and pepper, add and mix everything into a not too firm dough.

Cook the dumplings in a pressure cooker until firm.

Mixed salad

2	Peppers
6	Tomatoes
1	Cucumber
1	Lettuce head
4 tsp.	Mustard, hot
4	Shallots
8 tbsp.	Balsamic vinegar, white
12 tbsp.	Olive oil
2 tsp.	Salt
4 tsp.	Sugar
4 tsp.	Mustard, sweet
20 tbsp.	Water
4 tsp.	Vegetable stock powder
A little	Salt & pepper

Cut the vegetables, mix the spices and shallots and pour over the salad.

White Beer “Champagne” Tiramisu [c, g, h, 1, 2]

8	Egg yolk
8 tbsp.	Sugar
2	Vanilla pods
500 g	Mascarpone
200 ml	Whipped cream
20 g	Sponge fingers
200 ml	Espresso
1 Bowl	Raspberries
1 Bowl	Blueberries
100 ml	Sparkling wine
100 ml	White beer
100 g	White chocolate shavings
16 Leaves	Mint

Beat the egg yolks with the sugar and vanilla pulp until white creamy. Fold in the mascarpone and stiffly whipped cream.

Cut half of the sponge into cubes and divide between 8 glasses. Drizzle with the espresso. Put the blueberries in the glasses. Pour half of the cream on top and top with the remaining sponge cubes. Mix the sparkling wine with wheat beer and soak the biscuits with it. Sprinkle the raspberries on top and finish with the remaining cream. Put the glasses in the fridge for about two hours. Garnish with chocolate shavings and mint before serving.

2. Allergens & Additives

Allergens:

a: Cereals containing gluten
B: Crustaceans and products thereof
C: Eggs and products thereof
D: Fish and products derived therefrom
E: Groundnuts and products derived therefrom
F: Soya (beans) and products thereof
G: Milk and products derived therefrom
H: Nuts
I: Celery and products derived therefrom
J: Mustard and products derived therefrom
K: Sesame seeds and products thereof
L: Sulphur dioxide and sulphites
M: Lupins and products derived therefrom

Additives:

1: Containing caffeine
2: Containing alcohol
3: With preservative
4: with flavour enhancer
5: with antioxidant
6: with phosphate
7: containing quinine
8: blackened

3. Cost evaluation and energy consumption of the menus

The following lists the cost of a portion, as well as the energy consumption of the entire menu and the resulting electricity costs. These only include the costs for the food in the dishes, which are bought in a local supermarket.

The costs for electricity, at 36.19 cents/kWh, refer to January 2022 and were published by the Bundesverband der Energie- und Wasserwirtschaft (BDEW).

Menu 1

Appetizer	2,33 €
Main course	6,30 €
Dessert	1,10 €
Total per portion	9,73 €
Energy consumption	1,4 kWh
Energy costs	0,51 €

Menu 2

Appetizer	2,20 €
Main course	4,73 €
Dessert	1,91 €
Total per portion	8,84 €
Energy consumption	0,70 kWh
Energy costs	0,25 €

Menu 3

Appetizer	1,56 €
Main course	5,38 €
Dessert	3,70 €
Total per portion	10,64 €
Energy consumption	1,2 kWh
Energy costs	0,43 €

Energy Consumption

Menue 1

	Time in min	Power in kW	Energy in kWh	
Obazda				
			0	
Radish - Cress Spread				
Mixer	3	0,5	0,025	
Tomato spread				
			0	
Tris of dumpling with sage butter - served with mixed salad				
Bread dumplings				
Stove M b	0,5	2,5	0,021	Dünsten Anheizen
Stove M 5	3	0,3	0,015	Dünsten
Stove S 7	8	0,5	0,067	Milch
Stove L b	3	3,4	0,170	DampfKT Anh
Stove L 5	5	0,5	0,042	DampfKT
Spinach dumplings				
Stove L b	0,5	3,4	0,028	Dünsten Anheizen
Stove L 5	8	0,3	0,04	Dünsten
Stove S 7	8	0,5	0,067	Milch
Stove L b	3	3,4	0,170	DampfKT Anh
Stove L 5	5	0,5	0,042	DampfKT
Beetroot dumplings				
Stove M b	0,5	2,5	0,021	Dünsten Anheizen
Stove M 5	3	0,3	0,015	Dünsten
Stove S 7	8	0,5	0,067	Milch
Stove L b	3	3,4	0,170	DampfKT Anh
Stove L 5	5	0,5	0,042	DampfKT
Sage butter				
Stove M b	0,5	2,5	0,021	Dünsten Anheizen
Stove M 5	10	0,3	0,5 2,5	Dünsten
Strawberry dumplings				
Stove M b	0,5	2,5	0,021	
Stove M 5	10	0,3	0,05	
Stove L b	3	3,4	0,170	Dampftopf ??? Stove L b
Stove L 5	5	0,5	0,042	oder im Wasser--> Stove L 5
Stove M b	0,5	2,5	0,021	
Stove M 5	4	0,3	0,02	
Sum			**1,4**	

Menue 2

	Time in min	Power in kW	Energy in kWh	
Sour Dumpling Carpaccio & Radish Carpaccio				
			0	
Potato pancakes sweet & savoury - served with mixed salad				
Potato pancakes				
Stove L b	0,5	3,4	0,028	
Stove L 7	15	2	0,500	
Bavarian cream				
Stove S 6	8	0,3	0,040	Milch
Stove M b	3	2,5	0,125	Wasserbad
Stove M 5	6	0,3	0,03	Wasserbad
Sum			**0,7**	

Menue 3

	Time in min	Power in kW	Energy in kWh	
Tomato gazpacho with toasted brown bread				
Mixer	2	0,8	0,027	
Stove M b	0,5	2,5	0,021	
Stove M 5	3	0,3	0,015	
Celery escalope on white wine - beetroot - mirror with bread dumplings, served with mixed salad				
Bread dumplings				
Stove M b	0,5	2,5	0,021	Dünsten Anheizen
Stove M 5	3	0,3	0,015	Dünsten
Stove S 7	8	0,5	0,067	Milch
Stove L b	3	3,4	0,170	DampfKT Anh
Stove L 5	5	0,5	0,042	DampfKT
Celery escalope				
Stove L b	2	3,4	0,113	Dampfkocht
Stove L b	0,5	3,4	0,028	Braten Anh.
Stove L 7	15	1,5	0,375	Braten
white wine - beetroot - mirror				
Stove M b	0,5	2,5	0,021	
Stove M 5	3	0,3	0,015	
Stove M 9	3	1,8	0,09	
Stove M 7	5	1,2	0,1	
White beer - Champagne Tirmaisu				
Stove S b	0,5	2,5	0,021	
Stove S 5	2	0,3	0,01	
Sum			**1,2**	

Appliances

Herd		
kleine Platte	1	0,05
	5	0,2
	9	1,3
	b	1,6
mittlere Platte	5	0,3
	9	1,8
	b	2,5
große Platte	5	0,3
	9	2,4
	b	3,4

Stabmixer	ca.	0,5

4. Nutritional information and local share of ingredients

Nutritional information

	Menu 1										
	Appetizer				Main course						Dessert
Nutritional information	Pretzel (100g)	Pretzel stick (100g)	Obazda (40g)	Radish cress smear (40g)	Tomato spread (40g)	Bread dumplings (100g)	Spinach dumplings (100g)	Beetroot dumplings (100g)	Sage butter (60g)	Mixed salad (200g)	Strawberry dumplings (120g)
Callorific value	941 kJ	865 kJ	580 kJ	420 kJ	430 kJ	1493 kJ	816 kJ	729 kJ	1799 kJ	360 kJ	1397 kJ
Calories	225 kcal	207 kcal	139 kcal	110 kcal	125 kcal	357 kcal	195 kcal	174 kcal	430 kcal	86 kcal	334 kcal
Protein	7,1 g	5,2 g	5,6 g	3,4 g	3,9 g	11,9 g	6,5 g	8,1 g	0,5 g	4 g	8,2 g
Carbohydrates	41,2 g	35,8 g	1,2 g	0,96 g	1,1 g	68,8 g	38,6 g	24 g	0,1 g	6 g	58,2 g
Fat	0,7 g	2,6 g	12,4 g	9,6 g	10 g	3,1 g	1,5 g	4,7 g	48,7 g	4 g	7,1 g

	Menu 2				
	Appetizer		Main course		Dessert
Nutritional information	Vinegar Dumpling Carpaccio (100g)	Radi Carpaccio (50g)	Potato pancakes (4St., ca. 60g)	Mixed salad (200g)	Bavarian Cream (105g)
Callorific value	1656 kJ	766 kJ	1728 kJ	360 kJ	1380 kJ
Calories	396 kcal	183 kcal	413 kcal	86 kcal	330 kcal
Protein	12 g	8 g	7,5 g	4 g	5,4 g
Carbohydrates	57,6 g	3 g	42,1 g	6 g	18,2 g
Fat	12,7 g	14 g	22,7 g	4 g	29 g

	Menu 3					
	Appetizer		Main course			Dessert
Nutritional information	Tomato Gazpacho (plate)	Brown bread (slice)	Celeriac escalope on a white wine and beetroot mirror (100g)	Bread dumplings (100g)	Mixed salad (200g)	White Beer Champagne Tiramisu
Callorific value	447 kJ	419 kJ	1159 kJ	1493 kJ	360 kJ	2393 kJ
Calories	107 kcal	100 kcal	320 kcal	357 kcal	86 kcal	572 kcal
Protein	4 g	4 g	11 g	11,9 g	4 g	17 g
Carbohydrates	14 g	19 g	36 g	68,8 g	6 g	45 g
Fat	4 g	0,5 g	17 g	3,1 g	4 g	34 g

According to the Techniker Krankenkasse, an adult man needs about 2500 kcal and an adult woman 1900 kcal a day. In total, the first menu provides 2382 kcal, menu two 1408 kcal and the third 1542 kcal. Thus, the first dinner covers 95% and 126% of the daily requirement. The meals at the second dinner provide 56% for men and 75% for women, and the last dinner provides 62% and 82% respectively. In comparison, one meal provides an average of about 1100 kcal. However, since the menus are three courses and provide an average of 2500 kcal, ours are within reason.

Local share of ingredients

Care has always been taken to ensure that all ingredients are produced or obtained regionally, seasonally and with as little energy input as possible. All fruit and vegetables, as well as cheese and eggs, can be obtained from a regional weekly market. The milk products come from a local dairy. Pretzels, breadcrumbs, dumpling bread and all other baked goods can also be obtained from a local baker. Only spices such as salt, pepper, vinegar and oil, as well as some ingredients for the desserts, for example flour, sponge cake, sparkling wine and wheat beer, have to be procured from a supermarket.

42 Contest Week Tasks‘ Planning

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

Note: For the activities highlighted in orange, not every Team is scheduled to do the activity on that day. The exact details of which Team is responsible for which task/activity at which time will be announced at a later date. However, a responsible person should be appointed.

	Responsibles			
Activities/Roles	Name of the Team Member 1	Name of the Team Member 2	Name of the Team Member 3	Name of the Team Member 4
11.06.2022		Saturday		
on site registration		All Team Members		
welcome ceremony		All Team Members		
health and safety training		All Team Members		
20.05. - 03.06.2022	Assembly Phase			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
assembly	All Team Members			
Faculty Advisor	Prof. Dr.-Ing. Jochen Stopper	Prof. Andreas Betz	Prof. Uli Spindler	Prof. Matthias Wambsganß
Project Manager	Yona Schmälzle	Andreas Boschert		
Health and Safety Team Coordinator	Andreas Boschert			
Teams Safety Officers	Daniel Maier	N.N. - follows		
Electrical Engineer	Rainer Mühlberger	Lukas Steiner	Erwin Resch	Markus Wirnsberger
Structural Engineer	Julian Scheuring			
Site Operations Coordinators	Giulia Bettini	Matthias Rummelsberger		
contact water delivery + removal	Michael Hobmaier	Sebastian Obermaier	Marinus Limbrunner	
notify appropriate inspector	Jakob Werner	Yona Schmälzle	Giulia Bettini	Sebastian Obermaier
contact instrumentation	Michael Hobmaier	Sebastian Obermaier	Marinus Limbrunner	
04. - 06.06.2022	Saturday-Monday			
contact for blower door test	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
07. - 09.06.2022	Tuesday-Thursday			
performance gap evaluation	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
10.06.2022	Friday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
opening ceremony	All Team Members			
Teams Safety Officers	Daniel Maier	N.N. - follows		
VIP public tours	Julia Bachmaier	Barbara Salzeder	Giulia Bettini	Sebastian Obermaier
jury visits CESA	Julia Bachmaier	Patricia Leitenbacher		
speed peer review	Julia Bachmaier	Patricia Leitenbacher		

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	Responsibles			
Activities/Roles	Name of the Team Member 1	Name of the Team Member 2	Name of the Team Member 3	Name of the Team Member 4
11.06.2022	Saturday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
puplic tours	Julia Bachmaier	Barbara Salzeder	Giulia Bettini	Sebastian Obermaier
jury visits CESA	Julia Bachmaier	Patricia Leitenbacher		
12.06.2022	Sunday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
puplic tours	Julia Bachmaier	Barbara Salzeder	Giulia Bettini	Sebastian Obermaier
jury visits CESA	Julia Bachmaier	Patricia Leitenbacher		
award ceremony (CESA)	All Team Members			
OOC award ceremony (Mirke Choice)	All Team Members			
13.06.2022	Monday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
privileged feed-in	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
contact for sound insulation test	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
drying	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dish washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
oven	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
cooking	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
home electronics	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
hot water draws	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
beverages delivery	Tim Ziegler			
food retrieval	Tim Ziegler			
control interior & exterior lighting	Giulia Bettini			
14.06.2022	Tuesday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
demand side management	Sebastian Obermaier	Andreas Boschert		
jury visits Affordability & Viability	Sabrina Sehnal	Julia Paternoster		
contact for sound insulation test	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	

Deliverable No.	D#6
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	Responsibles			
Activities/Roles	Name of the Team Member 1	Name of the Team Member 2	Name of the Team Member 3	Name of the Team Member 4
drying	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dish washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
oven	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
cooking	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
home electronics	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
hot water draws	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
beverages delivery	Tim Ziegler			
dinner hosts	Michael Hobmaier	Sebastian Obermaier	Nadja Pollack	Sabrina Sehnal
dinner visitors	Giulia Bettini	Marinus Limbrunner	Matthias Rummelsberger	Julia Bachmaier
user friedliness	Michael Hobmaier	Sebastian Obermaier	Nadja Pollack	Sabrina Sehnal
beverages delivery	Tim Ziegler			
dinner shopping	Tim Ziegler			
food retrieval	Tim Ziegler			
control interior & exterior lighting	Giulia Bettini			

15.06.2022	Wednesday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
jury visits Engineering & Construction	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
jury visits Affordability & Viability	Sabrina Sehnal	Julia Paternoster		
contact for sound insulation test	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
drying	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dish washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
oven	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
cooking	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
home electronics	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
hot water draws	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dinner hosts	Michael Hobmaier	Sebastian Obermaier	Nadja Pollack	Sabrina Sehnal
dinner visitors	Giulia Bettini	Marinus Limbrunner	Matthias Rummelsberger	Julia Bachmaier
user friedliness	Michael Hobmaier	Sebastian Obermaier	Nadja Pollack	Sabrina Sehnal
beverages delivery	Tim Ziegler			
dinner shopping	Tim Ziegler			
food retrieval	Tim Ziegler			
control interior & exterior lighting	Giulia Bettini			

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

Note: For the activities highlighted in orange, not every Team is scheduled to do the activity on that day. The exact details of which Team is responsible for which task/activity at which time will be announced at a later date. However, a responsible person should be appointed.

	Responsibles			
Activities/Roles	Name of the Team Member 1	Name of the Team Member 2	Name of the Team Member 3	Name of the Team Member 4
16.06.2022	Thursday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
puplic tours	Julia Bachmaier	Barbara Salzeder	Giulia Bettini	Sebastian Obermaier
jury visits Engineering & Construction	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
jury visits Sustainability	Giulia Bettini	Nadja Pollack		
washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
drying	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dish washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
oven	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
cooking	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
home electronics	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
hot water draws	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
award ceremony (Affordability & Viability)	All Team Members			
control interior & exterior lighting	Giulia Bettini			
17.06.2022	Friday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
puplic tours	Julia Bachmaier	Barbara Salzeder	Giulia Bettini	Sebastian Obermaier
contact water delivery + removal	Michael Hobmaier	Sebastian Obermaier		
jury visits Sustainability	Giulia Bettini	Nadja Pollack		
dish washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
oven	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
home electronics	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
hot water draws	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
food retrieval	Tim Ziegler			
award ceremony (Engineering & Construction)	All Team Members			
OOC award ceremony (Indoor Air Quality)	All Team Members			
OOC award ceremony (Solar)	All Team Members			
control interior & exterior lighting	Giulia Bettini			
18.06.2022	Saturday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

Note: For the activities highlighted in orange, not every Team is scheduled to do the activity on that day. The exact details of which Team is responsible for which task/activity at which time will be announced at a later date. However, a responsible person should be appointed.

	Responsibles			
Activities/Roles	Name of the Team Member 1	Name of the Team Member 2	Name of the Team Member 3	Name of the Team Member 4
puplic tours	Julia Bachmaier	Barbara Salzeder	Marinus Limbrunner	Michael Hobmaier
dish washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
oven	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
home electronics	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
hot water draws	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
award ceremony (Sustainability)	All Team Members			
OOC award ceremony (Craft)	All Team Members			
control interior & exterior lighting	Giulia Bettini			
19.06.2022	**Sunday**			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
puplic tours	Julia Bachmaier	Barbara Salzeder	Marinus Limbrunner	Michael Hobmaier
dish washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
oven	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
home electronics	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
hot water draws	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
OOC award ceremony (Timber Construction)	All Team Members			
control interior & exterior lighting	Giulia Bettini			
20.06.2022	**Monday**			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
privileged feed-in	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
contact for sound insulation test	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
drying	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dish washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
oven	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
cooking	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
home electronics	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
hot water draws	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
beverages delivery	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
food retrieval	Tim Ziegler			
control interior & exterior lighting	Giulia Bettini			

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

Note: For the activities highlighted in orange, not every Team is scheduled to do the activity on that day. The exact details of which Team is responsible for which task/activity at which time will be announced at a later date. However, a responsible person should be appointed.

	Responsibles			
Activities/Roles	Name of the Team Member 1	Name of the Team Member 2	Name of the Team Member 3	Name of the Team Member 4
21.06.2022	Tuesday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
demand side management	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
contact for sound insulation test	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
drying	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dish washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
oven	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
cooking	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
home electronics	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
hot water draws	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dinner hosts	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dinner visitors	Michael Hobmaier	Sebastian Obermaier	Nadja Pollack	Sabrina Sehnal
user friedliness	Giulia Bettini	Marinus Limbrunner	Matthias Rummelsberger	Julia Bachmaier
jury visits Urban Mobility	Michael Hobmaier	Sebastian Obermaier	Nadja Pollack	Sabrina Sehnal
beverages delivery	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dinner shopping	Tim Ziegler			
food retrieval	Tim Ziegler			
control interior & exterior lighting	Giulia Bettini			
22.06.2022	Wednesday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
public tours	Julia Bachmaier	Barbara Salzeder	Marinus Limbrunner	Michael Hobmaier
jury visits Architecture	Nadja Pollack	Giulia Bettini		
washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
drying	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
dish washing	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
oven	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
cooking	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
home electronics	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
hot water draws	Sebastian Obermaier	Michael Hobmaier	Marinus Limbrunner	
jury visits Urban Mobility	Tim Ziegler	Giulia Bettini		
award ceremony (Energy | Comfort | Functioning)	All Team Members			
OOC award ceremony (BIM)	All Team Members			
23.06.2022	Thursday			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

Note: For the activities highlighted in orange, not every Team is scheduled to do the activity on that day. The exact details of which Team is responsible for which task/activity at which time will be announced at a later date. However, a responsible person should be appointed.

	Responsibles			
Activities/Roles	Name of the Team Member 1	Name of the Team Member 2	Name of the Team Member 3	Name of the Team Member 4
Teams Safety Officers	Daniel Maier	N.N. - follows		
puplic tours	Julia Bachmaier	Barbara Salzeder	Marinus Limbrunner	Michael Hobmaier
jury visits Architecture	Nadja Pollack	Giulia Bettini		
award ceremony (Urban Mobility)	All Team Members			
OOC award ceremony (Applied Mobility Sciences)	All Team Members			
OOC award ceremony (German Sustainable Housing)	All Team Members			
24.06.2022	**Friday**			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
public tours	Julia Bachmaier	Barbara Salzeder	Marinus Limbrunner	Michael Hobmaier
award ceremony (Architecture | Innovation | Final)	All Team Members			
25.06.2022	**Saturday**			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
public tours	Julia Bachmaier	Barbara Salzeder	Marinus Limbrunner	Michael Hobmaier
OOC award ceremony (Human Centered Interior Arch.)	All Team Members			
OOC award ceremony (Sustainable Arch. Lighting)	All Team Members			
26.06.2022	**Sunday**			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
Teams Safety Officers	Daniel Maier	N.N. - follows		
public tours	Julia Bachmaier	Barbara Salzeder	Marinus Limbrunner	Michael Hobmaier
OOC award ceremony (People's Choice)	All Team Members			
28.06. - 03.07.2022	**Disassembly Phase**			
team/organiser meeting	Prof. Dr.-Ing. Jochen Stopper	Yona Schmälzle	Andreas Boschert	
disassembly	All Team Members			
Faculty Advisor	Prof. Dr.-Ing. Jochen Stopper	Prof. Andreas Betz	Prof. Uli Spindler	Prof. Matthias Wambsganß
Project Manager	Yona Schmälzle	Andreas Boschert		
Health and Safety Team Coordinator	Andreas Boschert			
Teams Safety Officers	Daniel Maier	N.N. - follows		
Electrical Engineer	Rainer Mühlberger	Lukas Steiner	Erwin Resch	

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

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	Responsibles			
Activities/Roles	Name of the Team Member 1	Name of the Team Member 2	Name of the Team Member 3	Name of the Team Member 4
Structural Engineer	Julian Scheuring			
Site Operations Coordinators	Giulia Bettini	Matthias Rummelsberger		
contact water delivery + removal	Michael Hobmaier	Sebastian Obermaier	Marinus Limbrunner	
notify appropriate inspector	Jakob Werner	Yona Schmälzle	Giulia Bettini	Sebastian Obermaier
contact instrumentation	Michael Hobmaier	Sebastian Obermaier	Limbrunner	

43 Cost Estimate & Project Financial Summary Cost

Table of contents

43.1 Business & Fund-Raising Plan

Fund-raising is an essential part of the Solar Decathlon Europe competition. Around 50% of project expenditure is covered by public funding (BMWK and Wuppertal / Energy Endeavor Foundation). However, the other half of the estimated costs need to be covered through fund-raising. I.e. project participation without our partners and sponsors from industry and research would not be possible.

The development of a solid fund-raising plan was closely mentored by the TUAS Rosenheim legal and financial department. Three fundraising options were identified:

- Monetary donations and donations in kind (material)
- Donation of expenses (e.g. use of production facilities)
- The item on loan (e.g. machines)

Advertising effectiveness for donors/sponsors must be kept deliberately small in all paths. Active sponsoring with the levelup team actively generating an advertising performance for the sponsor was deliberately excluded by the legal office. With the remaining options, the TUAS Rosenheim partner network was approached. In contrast, the university tolerates when partners advertise without the levelup team‘s influence, as we have no control over this. However, we display the logos of our partners and mention them in our brochures.

In Step 1 possible key sponsors were identified in close cooperation with the TUAS Rosenheim president, the transfer manager, and different faculty advisory boards. Furthermore, CRM systems were browsed to identify close and frequent cooperation between the university and business partners in research and education.

Along with the project, further partners were identified (Step 2) due to special products or competencies needed throughout the building process. This could include:

- A special heading pump
- A customized elevator
- Steel construction for stairs
- Solar panels
- Construction site clothes
- …

Sponsors are regularly updated about the levelup progress through our newsletter, events (e.g. roofing ceremony), and meetings between the levelup sponsoring officer, faculty advisor, and/or president. New sponsors are frequently addressed through TUAS-wide newsletters and faculty magazines including a call to action to support the levelup team. Therefore a steady growth in partner networks is expected.

Through close cooperation with partners from industry and research, practical development in the SDE 21/22 is guaranteed, which can be transferred to industrial applications. This enables a practical development of the tasks required in the project. In addition, a solid foundation is laid for further cooperation in other follow-up projects. Networking between students and industrial partners also provides prospects for young professionals. As a university of applied sciences, this is where our focus lies.

As a result of our business and fundraising plan, we were able to attract nearly 90 partners and sponsors. Despite the rising costs in the construction industry, funds were successfully raised in this way. This made our participation in the SDE 21/22 possible.

Donations

In the nonprofit sector, the donor does not pursue its purposes and therefore does not expect the university to provide anything in return. For this reason, no contract is required. However, the donor receives a tax-deductible donation receipt from the Finance Department of the TUAS Rosenheim. In addition, the university voluntarily names the partners in the form of the phrase „with the kind support of“ and the representation of the logo. It does not come to any use in the economic field.

Passive Sponsorship

In contrast to a donation, passive sponsorship allows the donor to pursue his purposes. The university needs to tolerate its purposes. For these reasons, a sponsorship agreement is usually concluded, but verbal agreements are also legal with long-term partners. It also results in so-called tax-innocuous acquiescence benefits. This means that the university can name the partner as the sponsor. In addition, the sponsor logos are published on various print materials. It is important to ensure that no partner is given preferential treatment, i.e. all logos must be ordered alphabetically and in the same size. As with sponsorship, no VAT is to be charged on the sponsoring amount.

Active Sponsorship (Informative only)

Active sponsoring is completely avoided in this project, as otherwise, taxes need to be paid on the benefits. In addition, this would only unnecessarily increase the administrative workload. Active sponsorship allows individual partners and sponsors to be given special prominence in the competition (prominent placement of the logo on materials, billboards, banners, exhibition stands at conferences). However, we would like to name all partners equally in the project.

34.2 Fund-Raising Overview

table1_COST FORM

SDE 21/22 COMPETITION	
Lead applicant's abbreviation	ROS
Name(s) of participating university (or universities)	„Technical University of Applied Sciences Rosenheim“
Team's Name	levelup

N°	Name	Description	Cost	% Total	
			excluding VAT	including VAT*	on ex VATA
	Full Cost Calculation				
3.	DIRECT MATERIALS			79.754,01 €	0,00%
4.	DIRECT LABOUR			223.979,54 €	0,00%
5.	LABOUR OVERHEAD			85.320,00 €	0,00%
6.	CONSULTANTS			10.709,99 €	0,00%
7.	OTHER DIRECT COSTS			7.483,88 €	0,00%
8.	TRAVEL AND OTHER COST FOR FINAL PHASE			7.664,73 €	0,00%
9.	ASSEMBLY, TRANSPORT AND DISASSEMBLY PROCECCES			0,00 €	0,00%
10.	INSURANCE POLICIES			0,00 €	0,00%
		Personnel	0,00 €	414.912,15 €	0,00%

*Local expenses are calculated with local VAT rate. Expenses in Germany are calculated with German VAT rate. If you are in the position to be input tax deductible, please copy the whole column one step to the left.

table2_INCOME DETAILS

Company Name	Collaboration Details	Amount of support	% Total
Institutional Support			
Solar Decathlon Europe 2021/22	donation (monetary)	100.000,00 €	8,45%
Federal Ministry for Economics Affairs and Energy / Bavarian State Ministry for Housing, Building and Transport	funding (monetary)	565.678,62 €	47,80%
		665.678,62 €	56,25%
Industrial Partners & Sponsors			
B&O Bau Bayern GmbH	donation (monetary)	20.000,00 €	1,69%
B&O Bau und Projekte GmbH	donation (monetary)	10.000,00 €	0,84%
Bayerischer Bauindustrieverband	donation (monetary)	50.000,00 €	4,22%
Bosch Power Tools GmbH	donation (tools)	3.968,21 €	0,34%
BSH Hausgeräte GmbH	donation (material)	10.885,00 €	0,92%
Caala GmbH	donation (software license and personal)	8.400,00 €	0,71%
CampusRo Projektentwicklungs GmbH & Co. KG	donation (monetary)	5.000,00 €	0,42%
Cibes Lift Deutschland GmbH	donation (material)	20.960,98 €	1,77%
Dirk Söndgerath | Innovative Heiztechnik	donation (material)	4.607,13 €	0,39%
Duschl Ingenieure GmbH & Co. KG	donation (monetary)	5.000,00 €	0,42%
Ecoforest	donation (material)	7.400,00 €	0,63%
EFT-Systems GmbH / BYD Europe	donation (material)	4.000,00 €	0,34%
Fischbacher Gerüstbau	donation (monetary)	500,00 €	0,04%
Fronius Deutschland GmbH	donation (material)	4.000,00 €	0,34%
GRWS - Wohnungsbau- und Sanierungsgesellschaft der Stadt Rosenheim mbH	donation (monetary)	3.000,00 €	0,25%
Hauraton GmbH & Co. KG	donation (material and personal)	2.400,00 €	0,20%
Huber & Sohn GmbH & Co. KG	donation (material and personal)	25.000,00 €	2,11%
ift Rosenheim GmbH	donation (laboratories and personal)	30.000,00 €	2,53%
INTEWA GmbH	donation (material)	8.475,28 €	0,72%
Joulia SA	donation (material)	2.040,00 €	0,17%
Lignotrend Produktions GmbH	donation (material)	47.000,00 €	3,97%
MDT technologies GmbH	donation (material)	749,45 €	0,06%
Memodo GmbH	donation (material)	627,43 €	0,05%
Meteotest AG	donation (software license)	2.000,00 €	0,17%
Pröbstl Holz GmbH	donation (material)	8.680,63 €	0,73%
Quest Baukultur GmbH	donation (monetary)	10.000,00 €	0,84%
Rieder Bau GmbH & Co. KG	donation (monetary)	1.000,00 €	0,08%
Rotho Blaas SRL	donation (material)	7.500,00 €	0,63%
SAILER GmbH	donation (monetary)	1.500,00 €	0,13%
Schüller Möbelwerk KG.	donation (monetary)	8.000,00 €	0,68%
Seeoner Kreis e.V.	donation (material)	105.000,00 €	8,87%
STEICO SE	donation (material)	17079,64	1,44%
Valentin Software GmbH	donation (software license)	3.000,00 €	0,25%
W. Markgraf GmbH & Co. KG	donation (material)	30.000,00 €	2,53%
Zimmerei Lukas Germerott	donation (monetary)	2.000,00 €	0,17%
		469.773,75 €	39,70%
Other Income Details			
Sparkassenstiftung Zukunft für die Stadt und Landkreis Rosenheim		45.000,00 €	3,80%
Bundesministerium für Wohnen, Stadtentwicklung und Bauwesen | Wettbewerb Zukunft-Bau		3.000,00 €	0,25%
		48.000,00 €	4,06%
		1.183.452,37 €	

table3_DIRECT MATERIALS

No.	description	UNIT of MEAS.	QUANTITY	PRICE €	TOTAL	%
1.	STRUCTURE					31%
1.1	BEAMS					14%
	best wood Schneider - construction timber		1	10784,93	10784,93	
	Linnhuber - squared timber		1	320,84	320,84	11105,77
					0,00	
1.2	STRURTURAL PILLARS					3%
	Holzwerke Waal - ESB boards for 1st floor wall panelling		1	2389,12	2389,12	
					0,00	2389,12
					0,00	
1.3	STRUCTURAL FLOORS SLABS					2%
	Linnhuber - veneered plywood		1	249,48	249,48	
	ZEG - solid wood boards		1	1054,78	1054,78	1596,64
	Eisen Mayer - aluminium profiles		1	292,38	292,38	
1.4	PARTITION AND EXTERNAL WALL					12%
	Claytec - clay building panels		1	6420,61	6420,61	
	Resysta - UPB boards bathroom		1	3484,37	3484,37	9904,98
					0,00	
2.	ARCHITECTURE					1%
2.1	OPENINGS					
	Huber & Sohn/AGC interpane - windows		1	0,00	0,00	
	Rubner - doors		1	0,00	0,00	0
					0,00	
2.2	FINISHES					0%
					0,00	
					0,00	0
					0,00	
2.4	FURNISHING					1%
	Linnhuber - solid wood for furniture		1	1024,42	1024,42	
					0,00	1024,42
					0,00	
3.	SYSTEMS INSTALLATION					14%
3.1	PLUMBING SYSTEM					3%
	INTEWA - rainwater tanks		1	1557,00	1557,00	
	Tanks Direkt - water tanks		1	989,74	989,74	2546,74
					0,00	
3.2	HVAC					2%
	Kreiller - ventilation system including pipes & bits & pieces		1	1416,11	1416,11	
					0,00	1416,11
					0,00	
3.3	ELECTRICAL SYSTEM					1%
	Div. - various small parts for electrical installation		1	518,82	518,82	
	Rexel - Gira switches and sockets		1	75,12	75,12	593,9
	MDT technologies - various voltage supplies		1	0,00	0,00	

3.4	LIGHTING					0%
					0,00	
					0,00	0
					0,00	
3.5	SOAL SYSTEMS					8%
	DualSun - PVT modules		1	6594,94	6594,94	
					0,00	6594,94
					0,00	
3.6	TELECOMUNICATIONS AND BUILDING AUTOMATIZATION					0%
					0,00	
					0,00	0
					0,00	
4	COMPETITION FEATURES					53%
4.1	STRUCTURAL FEATURES					18%
	Rotho Blaas - screws, (structural) fittings		1	14073,88	14073,88	
					0,00	14073,88
					0,00	
4.2	FIRE SUPRESSION					0%
					0,00	
					0,00	0
					0,00	
4.3	APPLIANCES					29%
	Cibes - lift		1	22765,89	22765,89	
	BSH - kitchen appliances & washing mashine/dryer		1	0,00	0,00	23331,14
	Adam + Stratmann - kitchen sink		1	565,25	565,25	
4.4	FURNITURE					6%
	ZEG - birch plywood, MDF		1	1006,00	1006,00	
	Häfele - furniture fittings		1	3812,17	3812,17	5176,33
	ZEG - HPL + edges		1	358,16	358,16	
	SWISS KRONO - particle board for furniture		1	0,00	0,00	
					TOTAL	79754,01

table4_DIRECT LABOUR

No.	description	UNIT of MEAS.	QUANTITY	PRICE €	No. OF LABOURS	TOTAL
1.	LABOURERS					
1.1						
	Project Manager		1	109929,81	1	109.929,81
1.2						
	Team Member		1	11386,86	1	11.386,86
1.3						
	Team Member		1	4002,91	1	4.002,91
1.4						
	Student Assistants 2020		7	2608,76	1	18.261,32
1.5						
	Student Assistants 2021		18	3456,36	1	62.214,48
1.6						
	Student Assistants 2022		16	1136,51	1	18.184,16
					TOTAL	223.979,54

table5_LABOUR OVERHEAD

No.	description	UNIT of MEAS.	QUANTITY	PRICE €	No. OF LABOURS	TOTAL
1.	PROFESSORS AND RESEARCHERS					
1.1						
	faculty advisor		6,5	2700	1	2700
	Advisory board		3	2700	7	56700
2.	GRANTED STUDENTS					
2.1						
						0
						0
3.	ADMINISTRATIVES					
3.1						
	Finance, Reporting		170	45	1	7650
	Legal		13	45	1	585
	IT		13	45	1	585
	Sponsoring		10	45	1	450
	Project Management		40	45	1	1800
					TOTAL	85.320,00 €

table6_CONSULTANTS

No.	description	UNIT of MEAS.	QUANTITY	PRICE €	No. OF LABOURS	TOTAL
1.1						
	structural engineering		1	10709,99	1	10709,99
						0
						0
						0
						0
						0
					TOTAL	10709,99

table7_OTHER DIRECT COSTS

No.	description	UNIT of MEAS.	QUANTITY	PRICE €	TOTAL
1.	GENERAL&ADMINISTRATIVE EXPENSES				
1.1	INDIRECT EXPENSES				
					0
					0
1.2	SECURITY				
					0
					0
1.3	MODEL				
1.3.1	Polystyrene (white, matt) 0,30 x 495 x 1000 (size)	pcs.	1	4,5	4,5
1.3.2	Polystyrene (white, matt) 0,50 x 495 x 1000 (size)	pcs.	1	5,9	5,9
1.3.3	Double-sided Adhesive Foil (Roll with 10 metres)	pcs.	1	119	119
1.3.4	Snap-off Blades for Cutters (Standard 9 mm, Box of 10)	pcs.	1	2,4	2,4
1.3.5	3M Creativ Mount Spray Glue (400 ml)	pcs.	1	22,9	22,9
1.3.6	Polyester Fine Filler (Tin 1,0 kg incl. Hardener)	pcs.	1	23,9	23,9
1.3.7	Islandmoos (approx. 1,0 kg)	pcs.	1	37,5	37,5
1.3.8	Unpainted Detailed Figures (Box with 10 Figures, Standing)	pcs.	1	6,9	6,9
1.3.9	MDF Panel (600 x 800 mm)	pcs.	5	9,9	49,5
1.3.10	Unpainted Detailed Figures (Box with 10 Figures, Sitting)	pcs.	1	7,5	7,5
1.3.11	Vellum Drawing Paper, Pastel Prey (500 x 650)	pcs.	10	2,2	22
1.3.12	Vellum Drawing Paper, Grey (500 x 650)	pcs.	5	2,2	11
1.3.13	Vellum Drawing Paper, White (500 x 650)	pcs.	10	2,2	22
1.3.14	Vellum Drawing Paper, Grey-Brown (500 x 650)	pcs.	5	2,2	11
1.3.15	Vellum Drawing Paper, Black (500 x 650)	pcs.	5	2,2	11
1.3.16	Vellum Drawing Paper, Dark Green (500 x 650)	pcs.	5	2,2	11
1.3.17	Acryl Hood including Shipping and Packaging	pcs.	2	214,2	428,4
1.3.18	Construction Plywood inc. Shipping and Packaging	sqm	3,31	17,83	55,81
1.3.19	Galvanised Box Lock	pcs.	16	3,3	52,8
1.3.20	Galvanised Locking Hooks	pcs.	16	1,1	17,6
1.3.21	Galvanised Box handle	pcs.	8	4,95	39,6
1.3.22	Galvanised Folding carrier Multi-Linc	pcs.	8	13,5	108
1.3.23	Varous Construction Plywood inc. Shipping and Packaging	pcs.	1	291,92	291,92
1.3.24	Colour Lacquer Spray	pcs.	5	8,99	44,95

1.3.25	Colour Lacquer Spray	pcs.	4	9,29	37,16
1.3.26	Colour Varnish	pcs.	1	15,99	15,99
1.3.27	Glue	pcs.	1	4,69	4,69
1.3.28	Roller Set	pcs.	1	3,19	3,19
1.3.29	Spray	pcs.	2	9,49	18,98
1.3.30	Colour Varnish	pcs.	1	8,99	8,99
1.3.31	Edding Fugen	pcs.	1	6,29	6,29
1.3.32	Edding Industrie	pcs.	1	4,99	4,99
1.3.33	Insulating and Protective Lacquer Spray	pcs.	1	9,99	9,99
1.3.34	Polystyrene Primer	pcs.	2	6,99	13,98
1.4	COMMUNICATION ACTIVITIES				
1.4.1	Short Animation Film for DEL#3		1	1.160	1.160
1.4.2	Jamendo Licensing | Music Licence for Image Film		1	40	40
1.4.3	Hosting for Project Website levelup-ro.de 01.06.2021: 1,22175 (277,70 USD)		1	227,3	227,3
1.4.4	Website Business Edition Tool 01.06.2021: 1,22175 (149,64 USD)		1	122,48	122,48
1.4.5	Printing Costs for Flyer		1	41,1	41,1
1.4.6	Update Short Animation Film for DEL#4 + Graphic Art Work		1	678,3	678,3
1.5	WORKSHOP				
1.5.1	Food Expenses Project Workshop with External Coach		1	25,58	25,58
1.5.2	Project Workshop #1 with External Coach		1	1276	1276
1.5.3	Travel Expenses for External Coach		1	409,6	409,6
1.5.4	Food Expenses Workshop for DEL#3		1	90,9	90,9
1.5.5	Project Workshop #2 with External Coach		1	1160	1160
1.6	LITERATURE				
1.6.1	Literature Indoor Greening	pcs.	1	38,75	38,75
1.6.2	Literature for the Use of Grey Water	pcs.	1	55,7	55,7
1.6.3	Literature Solar Architecture		1	26,1	26,1
1.7	VAROIUS, DIRECT COSTS				
1.7.1	Travel Expenses to see Urban Situation (Nuremberg)		1	68,3	68,3
1.7.2	Christmas Present for Student Team Leaders		1	114,6	114,6
1.7.3	MagiCAD-License	pcs.	2	30	60
1.7.4	FFP2 Masks for Photo Shooting for DEL#3	pcs.	1	8,77	8,77
1.7.5	Online-Conference Fees Bayern Innovativ		1	23,8	23,8
1.7.6	Prototype structure façade	pcs.	1	325,48	325,48
				TOTAL	7.483,88 €

table8_TRAVEL AND OTHER COST FOR FINAL PHASE (Wuppertal)

No.	description	UNIT of MEAS.	QUANTITY	PRICE €	TOTAL
1.1	Solar Decathlon Middle East 2021				
	Andreas Boschert; Dubai; Visit to Solar Decathlon Middle East 2021		1	1200	1200
	Michael Hobmaier; Dubai; Visit to Solar Decathlon Middle East 2021		1	1200	1200
	Julia Bachmaier; Dubai; Visit to Solar Decathlon Middle East 2021		1	1200	1200
	Sebastian Obermaier; Dubai; Visit to Solar Decathlon Middle East 2021		1	1200	1200
	Andreas Boschert; Munich; Visit to the fair and conference „The Smarter E“		1	17,2	17,2
	Andreas Boschert; Wuppertal; Team Workshop #2		1	579,37	579,37
	Sebastian Obermaier; Wuppertal; Team Workshop #2		1	206,77	206,77
	Michael Hobmaier; Wuppertal; Team Workshop #2		1	206,77	206,77
	Andreas Boschert; Berlin; Participation in the forum „NEUE ENERGIEWELT“		1	452,6	452,6
	Barbara Salzeder; Berlin; Participation in the forum „NEUE ENERGIEWELT“		1	401,85	401,85
	Michael Hobmaier; Berlin; Participation in the forum „NEUE ENERGIEWELT“		1	411,3	411,3
	„Transport and handover of the architectural model from Rosenheim to Wuppertal (fuel bill)“		1	150,65	150,65
	„Transport and handover of the architectural model from Rosenheim to Wuppertal (rental car)“		1	300,83	300,83
	Excursion with the SDE-team to the company „Sunovation“ (sponsor in the SDE21/22 competition) in Aschaffenburg		1	137,39	137,39
				TOTAL	7664,73

table9_ASSEMBLY, TRANSPORT AND DISASSEMBLY PROCECCES

No.	description	UNIT of MEAS.	QUANTITY	PRICE €	TOTAL
1.	DISASSEMBLY IN ORIGIN				
					0
					0
2.	Transport				
					0
					0
3.	ASSEMBLY IN DESTINATION				
					0
					0
4.	DISASSEMBLY IN DESTINATION				
					0
					0
				TOTAL	0

nothing incurred yet.

table10_INSURANCE POLICIES

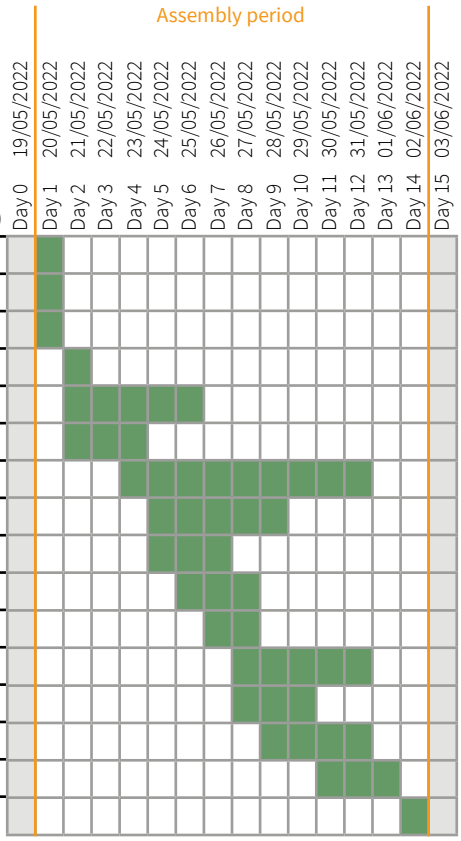
No.	description	UNIT of MEAS.	QUANTITY	PRICE €	TOTAL
1.1					
					0
					0
				TOTAL	0

Completed but no bill yet.

44 Site Operations Plan

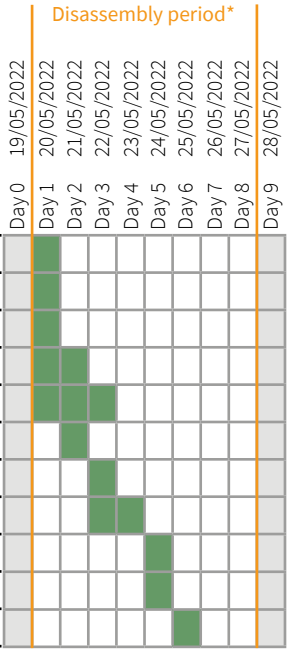
Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

team ID	Pos.	Description	Start Date	End Date	Duration (days)
ROS	1	Assembly Start	20/05/2022	20/05/2022	1
	2	Foundations	20/05/2022	20/05/2022	1
	3	Modules	20/05/2022	20/05/2022	1
	4	Site Setup	21/05/2022	21/05/2022	1
	5	Facade	21/05/2022	23/05/2022	3
	6	1st floor walls & ceiling	21/05/2022	23/05/2022	3
	7	Electrical installation	23/05/2022	31/05/2022	9
	8	Steelwork	24/05/2022	28/05/2022	4
	9	Lift installation	24/05/2022	26/05/2022	3
	10	Plumbing installation	25/05/2022	27/05/2022	3
	11	Furniture and interior details	26/05/2022	27/05/2022	2
	12	Exterior patio, plattforms, slat screen	27/05/2022	31/05/2022	5
	13	1st floor patio and garden	27/05/2022	29/05/2022	3
	14	House connection and testing	28/05/2022	31/05/2022	4
	15	Clean up	30/05/2022	01/06/2022	3
	16	Final building inspection	02/06/2022	02/06/2022	1



* For the Living Lab Teams there is no need to fill in the Disassembly period.

team ID	Pos.	Description	Start Date	End Date	Duration (days)
ROS	1	Disassembly Start	27/06/2022	27/06/2022	1
	2	Furniture and interior details	27/06/2022	27/06/2022	1
	3	Exterior patio, plattforms, slat screen, garden	27/06/2022	27/06/2022	1
	4	Plumbing/electrical installations	27/06/2022	28/06/2022	2
	5	Lift	27/06/2022	29/06/2022	3
	6	Steelwork	28/06/2022	28/06/2022	1
	7	1st floor walls & ceiling	29/06/2022	29/06/2022	1
	8	Facade	29/06/2022	30/06/2022	2
	9	Modules	01/07/2022	01/07/2022	1
	10	Foundations	01/07/2022	01/07/2022	1
	11	Site clean up & final approval	02/07/2022	02/07/2022	1



45 HS Report & Documentation

Table of contents

1. Health & Safety Checklist

LEGAL CONTENTS	LOCATION IN THE REPORT OR IN DRAWINGS
Name and address of SDE21/22 HS Coordinator, Prevention authorities, Team	2.2., 2.3, 2.4
Number of workers	2.4.
Contact information of the Site Operations Coordinator	2.2
Description of works	5.11.
First aid procedure	13.
Name and number of first aid certificated worker	2.2., 2.4
Description of the Team's first aid kit.	5.13
Description of hygiene conditions (toilet, changing room, restroom…)	11.
Detailed description of operating modes	5.5.
Risk assessment – risks generated by other	14
Risk assessment – risks generated by environment	14
Risk assessment – risks generated on other	14
Risk assessment – self-generated risks	14
Procedures to adapt collective protection	9.

Table 1: Template Health & Safety Checklist according to SDE21 Rules V_2.2

2. General project data

The levelup student team from the Rosenheim Technical University of Applied Sciences is taking part in the Solar Decathlon Europe 21/22 competition (abbreviated as SDE21/22), the finals of which are be hosted in Germany for the first time from 10th – 26th of June 2022.
Our team consists of many creative and curious minds and engineering drive . All in all, eighteen university teams from eleven countries will operate solar houses at the Solar Campus in the Mirker district in Wuppertal. The competition and the buildings will demonstrate concrete and transferable solutions for sustainable building and future living in urban areas. The levelup team will show its ideas and visions by presenting a two-storey wooden building. The house consists of three mod-ules on the ground floor, which constitute a residential unit. On the upper floor there is a roof terrace and greenhouse.

The competition site and the House Demonstration Units (abbr. HDU) will be open to visitors from all over the world for a fixed period of two weeks, during which 150,000 visitors are expected. Over a project period of about two years, the teams plan, build and operate fully functional modular buildings based on sustainable and energy-efficient architecture, which meetmust comply with ten different competition requirements. The competition categories deal with some of the biggest challenges of the construction industry: The creation of affordable housing by refurbishing building stock and the climate neutrality of cities, the biggest factor in the energy transition. For the event, the modular prototypes are first prefabricated and pre-assembled on location at the respective participating universities before they are transported to Wuppertal for final assembly. Upon completion of the competition, eight demonstration buildings will stay at the Solar Campus for the living.lab NRW. The remaining ten buildings will be disassembled at the end of the competition and transported back to their respective home countries. The competition buildings are then com-monly reassembled for further research, development and education, either on the respective uni-versity‘ s campus or at a selected national location. This will also be the case with our team. Our competition participation and project is supported by the Federal Ministry for Economic Affairs and Energy, the Bavarian State Ministry for Housing, Con-struction and Transport.

In addition, we are being supported by partners and sponsors from research and industry in the form of monetary and material donations, as well as planning support. Without their cooperation, the project would not have been feasible.

2.1. Aim of the Health and Safety Plan

The aim of the Health and Safety Plan is to ensure that the construction site runs smoothly and ensures that all crew members are aware of potential hazards. In addition, all crew members must be trained on accident prevention regulations. The Health and Safety documents are an important part of the assembly and disassembly phase and must be accessible at all times.

2.2. Health and Safety Coordinators and crew members (Name and address HS Coordinator)

Site Operations Coordinators (SOC) work together closely with the Health and Safety (H&S) officers. There is one coordinator per shift for site logistics and site safety.

Health and Safety Coordinators / Officers are:

Name: Andreas Boschert
Address: Hochschulstraße 1
Postal Code and City: 83024 Rosenheim (Germany)
Phone: +49 (0) 8031 805-2625
Email: andreas.boschert@th-rosenheim.de

Name: Daniel Julian Maier
Address: Hochschulstraße 1
Postal Code and City: 83024 Rosenheim (Germany)
Phone: +49 (0) 8031 805-XXXX
Email: danieljulian.maier@stud.th-rosenheim.de

Note: Phone number is forwarded to the smartphone, ensuring non-stop availability! For Mr. Maier, the extension number will be provided in D#6.

The levelup team is divided into two working groups during the assembly and disassembly phases. In each team there is a Health and Safety Coordinator, as well as a Site Operations Coordinator. All construction crew, including external partners, are under obligation to work according to the Health and Safety Plan and to comply with all specifications and rules.

Contact information of the Site Operations Coordinator

Name: Yona Schmälzle
Address: Hochschulstraße 1
Postal Code and City: 83024 Rosenheim (Germany)
Phone: +49 (0) 8031 805-XXXX
Email: jona.schmaelzle@th-rosenheim.de

Note: Phone number is forwarded to the smartphone, ensuring non-stop availability! For Ms. Schmälzle , the extension number will be provided in D#6.

2.3. Construction Sites

The House Demonstration Unit will be built in two construction sites, as stated below:

Name of the site #1: Bogensiedlung at Technical University of Applied Sciences Rosenheim
Address: Hochschulstraße 1
Postal Code and City: 83024 Rosenheim (Germany)

Name of site #2: Solar Campus at Utopiastadt (Mirker Bahnhof)
Address: next to Mirker Straße 48
Postal Code and City: 42105 Wuppertal (Germany)

2.4. Team

All levelup-team members in the table below can provide first aid, because they have all been certificated to do so. In case of an emergency, please call Andreas Boschert and Daniel Maier (phone numbers in section 2.2.).

Name	Position	E-Mail
Andreas Boschert	Project Manager, HS Team Coordinator	andreas.boschert@th-rosenheim.de
Sebastian Obermaier	Energy and building engineer	sebastian.obermaier@th-rosenheim.de
Michael Hobmaier	Energy and building engineer	michael.hobmaier@th-rosenheim.de
Marinus Limbrunner	BIM engineer	marinus.limbrunner@th-rosenheim.de
Giulia Bettini	Architect	giulia.bettini@th-rosenheim.de
Nadja Pollack	Architect	nadja.pollack@th-rosenheim.de
Nadine Socher	Architect	nadine.socher@th-rosenheim.de
Barbara Salzeder	Communication Coordinator	barbara.salzeder@th-rosenheim.de
Julia Bachmaier	Communication Coordinator	julia.bachmaier@th-rosenheim.de
Julia Paternoster	Communication Coordinator	julia.paternoster@th-rosenheim.de
Jakob Werner	Sponsorship Manager	jakob.werner@stud.th-rosenheim.de
Sabrina Sehnal	Business economist	sabrina.sehnal@th-rosenheim.de
Tim Ziegler	Urban Mobility Coordinator	tim.ziegler@th-rosenheim.de
Daniel Maier	Team Safety Officer	danieljulian.maier@th-rosenheim.de
Unknown	Team Safety Officer	

Currently our team consists of thirteen students, and at the competition there will be 30 people on site at any one time for assembly and disassembly. The names will be finalized shortly before the competition starts.

3. Health & Safety Plan objectives

Health & Safety plans are prepared in order to ensure a trouble-free performance of the competition (assembly, operation and disassembly). This includes a detailed and comprehensive plan to prevent personal injury and property damage before, during and after the competition. The aim of the plan is to identify individual risks for specific work steps and to prevent possible accidental hazards, as well as to define general accident prevention regulations. The risks and dangers are formulated and dis-cussed among the entire levelup team and all supporting members of the industry that are to assist on site. This ensures that all crew members become acquainted with the Health & Safety Plan and are sensitized to the potential dangers on the construction site. Through extensive analyses and work, we hope that the duration of the project will be accident free, because our primary goal is the health and safety of all team members and visitors. Property damage should of course also be avoided, but health and safety is one of our primary concerns. In the event of personal injury or damage to property, the H&S Plan should clearly define all procedures and make them known to all team members. This guaran-tees a trouble-free process, even in the case of accidents. Additionally, insurance policies have to be signed to cover the eventuality of any damage or injury. The levelup team and the SDE event organizer are to work very closely together to ensure that the competition ends incident free.

To sum it up:

- Provide all team members and the organizer with an overview of all health and safety topics
- Provide details of assembly and disassembly in order to ensure a safe process
- Provide instructions and guidance in the event of an emergency
- Identifying and avoiding risks

4. Instruction concept including contents

- All team members must have read, understood and internalised the health and safety report including all plans. Should any ambiguities, problems or errors arise, these must be discussed immediately with the Team Safety Officer. All team members must understand and be in-formed about the following topics according to DGUV Regulation 1 – **Principles of Prevention:**
  - specific hazards related to the workplace and work tasks,
  - protective measures taken and to be observed against this,
  - intended safety and health compliant actions (behaviour),
  - emergency measures,
  - relevant contents of the rules and regulations.
- All team members must wear Personal Protective Equipment (PPE) during the assembly and disassembly phases. Safety clothing must comply with German specifications for the construction site: helmet (DIN EN 397), goggles, safety gloves (EN 420/388), hearing protection, safety boots with steel toe cap and anti-slip sole (EN ISO 20345), reflective jacket and work trousers with knee pads (DIN EN 14404) / reflective waistcoat (EN ISO 20345). Depending on the task onf the construction site, the PPE can be extended. All team members will be briefed on the safety equipment. If a team member does not wear PPE, they are to be strictly forbidden from working on the construction site.
- All team members will be instructed that participation in the assembly and disassembly phases is not permitted under the influence of drugs and alcohol, or medicines that would affect the operation of heavy equipment. All of which are prohibited.
- Smoking is also prohibited on the site.
- Instruction also includes first-aid training, fire extinguisher training, instruction on machines and equipment (operating in-structions, operating manual and risk assessment).
- All team members must attend the health & safety training in advance, because all necessary information, rules and regulations will be taught during these sessions. Participation will be documented in writing.

5. Construction-site conditions and crucial data related to the prevention of risks during the construction process

The House Demonstration Unit will be set up in Wuppertal from 20 May to 02 June 2022 and disas-sembled from 27 June to 3 July 2022. During this time, the implementation of health and safety plans is crucial to ensure a safe construction site. The objective is to reduce risks and hazards as the project is completed, i.e. the construction project. All employees must aim to achieve the objectives of the plan and adhere to all specifications - no deviations are permitted. Safety awareness is essential. In this sense, the plans are oriented towards a safe and healthy workplace. This includes preventive action in addition to compliance with all laws and regulations.

The Health and Safety Coordinator is responsible for ensuring compliance with the health and safety plans. This person has the task of pointing out the need for compliance and, as the person responsible for the construction site, must inspect the site daily and determine whether the objectives have been achieved. In case of unforeseen events, safety measures must be defined or improved.

5.3. Construction process

At the beginning of construction, the lot must be prepared for construction measures. However at the very beginning, the team needs to be and briefed on the safety procedures in place. This briefing will take place every day before each shift. It is here that, tasks, expectations and problems are discussed and reviewed. The Team Safety Officer Oofficer will also point out the necessary protective equipment and hazards. In addition, regular health and safety training will take place, where e.g. fire extinguishers, first-aid kits and escape routes are to be pointed out.

A site fence will be installed around the construction site, enclosing the entire lot. The fences are to be closed during the entire construction phase and prevent any unauthorised access. All crew members must use the correct entrances and exits, thus avoiding possible accidents and enabling documentation of attendance. Another important step is the assembly of the contain-ers for the construction site equipment. The entire lot must be clean and tidy during the con-struction phase. At the end of the day, all tools in the site container must be tidied up and checked for functionality and damage. In this way, a problem-free continuation of work for the next day/shift is possible. Any damage must be reported to the Site Operations Coordinator.

Construction begins by positioning, steel plates as a foundation. These are to be lifted from the truck with a crane. While loads are being lifted, no team member is allowed to be within the movement radius of the crane! The Team Safety Officer checks that the regulations are followed and that accidents are prevented. Afterwards, the three wooden modules for the ground floor will be gradually lifted from the trucks and positioned on the foundation. Again, no one is allowed to be within the movement radius of the crane. In addition, it must be ensured that the modules are properly fastened and do not swing during unloading. During the work, only necessary work-ers are allowed on the lot. Communication will be conducted with hand signals and two-way radios. Wearing PPE is obligatory. In addition, attention must be paid to the weather (especially wind). The staircase, including the technical room and the pergola, will then be positioned. The same requirements apply here as for the wooden modules. The upper floor, consisting of two modules, will then be assembled. Special attention must be paid to work on the upper floor. All people working on the roof will have already undergone training in Rosenheim and must be tested for balance and their ability to cope with vertigo. No other team members are allowed on the roof, without exception! Team members with experience on construction sites and climbing will work on the roof, as safety harnesses and safety lines must be worn. The Health and Safety officer must inspect the roof and approve it for further construction. Care must be taken to ensure that there are no gaps or tripping hazards, and that fall protection is in place. There are several things to consider when it comes to interior design. All work must be conducted with the right tools and aids. Heavy furniture must not be lifted, but transported with lifting aids. Since the area of movement isare limited, care must be taken to ensure mutual consideration. Accordingly, the number of people working at any given time should be limited All escape routes must be kept clear at all times! The disassembly phase shall be done in the exact reversed order as in the assembly-phase.

5.4. Type and characteristics of the materials and elements

All products and materials are to have quality seals. If necessary, spot checks will be carried out. If materials do not meet the requirements or are defective / broken, they will be replaced. After all materials are checked by the manufacturer, and then double-checked during assembly in Rosenheim, dangers or problems should be limited. However, attention must be paid to at least the following parameters:

- Insure that all building materials have the correct dimensions incl. tolerances and that the materials meet the claims (e.g. strength, thickness)
- Determine tolerances for components and check that they fit together and have not been damaged during transport
- Check insulation, technical equipment and quality

These verifications will occur in two phases:

1. Upon delivery, it must be ensured that all components comply with the specifications and requirements and function. The manufacturer or installer can also conduct this through assessments and test
2. Manufacturer inspection or a measuring check that can certify that the various parts have been properly installed and are in working order

In addition, the following requirements apply to all materials and equipment:

- All materials must comply with fire protection standards
- All materials must have the CE mark and data sheets must be available for all components
- All installations must be properly installed and approved

5.5. Site description

Each university team receives its own lot on the Solar Campus. This consists of the parking area for the truck, a working area and the installation area for the HDU. Site layout is one possible means to minimise hazards and risks. The HDU site will be analysed accordingly in order to re-duce risks to a minimum. Before the construction, the lot will be enclosed with a construction fence. In case of an emergency, the fence protects the area and ensures that the construction crew use the correct evacuation routes. The working area provides space for a site container and a crane. To avoid the risk of accidents and to protect tools, all equipment must be tidied up immediately and placed in the site containers when not needed. Various areas are marked and secured with construction tape and signs mark danger areas and provide information.

On the Solar Campus, the competition organizer provides sanitary facilities as well as break rooms for all teams. As a total of 18 teams will be building their HDUs in parallel to one another, special consideration and care must be taken of each other, especially with direct neighbours.

The entrance to the construction site is organised by the Site Operations Coordinator. All team members must comply with the following regulations:

- All workers (both students and external partners) must be familiar and comply with the rules! Compliance will be checked by the Team Safety officer. If this is not the case, follow-up training will be required. The instructions are documented in writing
- All workers are required to wear PPE
- Work is only to be done as directed by the Site Operation Coordinator

5.6. Climate description

One very important aspect before starting work is the evaluation of climatic conditions and their influence on the construction phase, in connection with a continuous observation of the weather. Extreme weather conditions can slow down, stop or endanger assembly and disassembly work. A constant, observant view of the sky and an eye on weather forecasts are essential for a well-planned execution of tasks. It also helps to avoid dangerous situations on the construction site. Appropriate emergency warning apps will be installed on the smartphones of the Site Operations Coordinator and the H&S officerTeam Coordinator. For example, NINA is an app that is recommended in Germany, and is provided by the Federal Office of Civil Protection, which is is used to send important or urgent warnings to the public. Katwarn is also used to disseminate warnings from civil protection and disaster control in dangerous situations.

In Wuppertal, average temperatures in June and July are between 19 to 21 degrees with the highest temperatures ranging from 30 to 35 degrees. At night, it can go down to 10 and 14 degrees. During these months, an average of 9.5 hours of sunshine is not uncommon. The weather conditions in June and July range from very sunny to slightly cloudy to rainy. Strong thunderstorms can occur in the evening hour include wind, heavy rain and in some cases hail.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°C)	1,8	2,2	5,1	9,2	13,1	16,1	18	17,5	14,4	10,5	6	2,9
Min. temperature (°C)	-0,3	-0,5	1,5	4,7	8,7	11,7	13,9	13,6	10,9	7,8	3,9	0,9
Max. temperature (°C)	4	5,1	8,8	13,4	17,1	20,1	21,9	21,3	18	13,5	8,3	4,9
Rainfall (mm)	110	89	90	72	83	95	111	106	93	95	101	117
Humidity (%)	86	83	78	70	70	71	72	74	78	81	88	97
Days of rain	12	10	11	10	10	10	12	12	10	10	11	12
Sunshine hours	2,9	3,9	5,4	7,9	8,8	8,8	9,5	8,5	6,6	4,9	3,4	2,7

Table 2: Climate table Wuppertal (Germany)

As it can be seen from the values above, in the table provided individual protection is necessary to enable comfortable and safe work depending on weather situations. At midday and in the afternoon when temperatures are highest, it is important to ensure that all team members drink plenty of water. The Team Safety Coordinator should point this out to those conducting assembly and disassembly work involving heavy physical exertion. People should attempt to work (when possible), drink and rest in shadowy places. In addition, crew members should wear headgear that protect the head and face against intense sunshine. It is also advisable to use sunscreen on exposed skin to prevent sunburn.

5.7. Access and paths for vehicles

Security will be controlled by the SDE organizers. Only crew members with a badge have access to the Solar Campus. During the assembly and disas-sembly phase, only authorised people can enter the construction site. Everyone who enters the construction site must wear PPE and must have received a safety brief-ing. When vehicles enter the site, the drivers are to follow the safety procedures specifications and instructions. These procedures are to be provided by the SDE organizer and by our team to ensure that vehicle traffic is man-aged safely and properly. Each vehicle entering the site will be directed by a team member wear-ing a waistcoat. This person has the task of guiding arriving vehicles and guiding their return. This measure / procedure is important so that there are no misunderstandings, thus reducing the risk of injury. . This will result in a smooth running operation, which will have a positive effect on work efficiency. In addition, there is a Site Operations Plan for all vehicles entering the Solar Campus, which controls and reduces vehicle movement in the area. This plan is important in order to prevent traffic jams on site, which would otherwise cause significant delays and create confusion. The Site Operations Coordinator is responsible for this clearing process.

5.8. Determining factors for the house placing

The HDU is set up in the same orientation on both sites (Rosenheim and Wuppertal), so no re-thinking is necessary for the final assembly / disassembly, which makes the process easier. This helps the team to work safely and reduces the risk of accidents. At the university site, the sub-strate was prepared to resemble construction at the Bogensiedlung, which is nearly equivalent to the requirements at the Solar Campus in Wuppertal. This allows the handling heavy equipment like forklift trucks, etc..

5.9. Overlaps with the affected services and other activities on the environment, able to cause risks during the construction

During assembly and disassembly phases on the Solar Campus, the levelup team must strictly fol-low the rules of the organisers, and also respect neighbouring properties. Since all House Demonstration Units will be set up within two weeks, special care must be taken during set-up to avoid a hectic situation. Special care is needed when trucks and vehicles manoeuvre between the different lots. This requires not only good and understandable communication within the team, but also between the different teams and neighbours. In addition, precautions should be taken to reduce noise pollution that may occur, as the simultaneous construction process can lead to high noise volumes. There can also be safety risks if too many people are on the construction site at any one time. Therefore, access to the lot is controlled and the number of people is to be lim-ited. Team members from other universities are not allowed to enter the levelup lot.

5.11. Planned activities

No.	Task Name	Risk	Prevention checklist
#1	Site setup (Container, Fencing, etc.)	Bumping, squeezing	Unhurried working methods and clear communication, wear PPE
#2	Laying the foundation (steel plates)	Squeezing, knocked by objects or tools	Wear PPE, clear communication, proper tools, check tools
#3	Unloading the wooden module #1 from the truck with mobile crane	Bumping, squeezing	Safety briefing, be outside of crane radius, minimum workers on site, wear PPE, use tools properly, clear communication
#4	Positioning the ground floor module (#1) on the foundation and fasten and connect it to the foundation	Bumping, squeezing, knocked by objects or tools, fall from ladder	Safety briefing, be outside of crane radius, minimum workers on site, wear PPE, use tools properly, clear communication
#5	Unloading the wooden module #2 from the truck with mobile crane	Bumping, squeezing	Safety briefing, be outside of crane radius, minimum workers on site, wear PPE, use tools properly, clear communication
#6	Positioning the ground floor module (#2) on the foundation and fasten and connect it to the foundation and to wooden module #1	Bumping, squeezing, knocked by objects or tools, fall from ladder	Safety briefing, be outside of crane radius, minimum workers on site, wear PPE, use tools properly, clear communication
#7	Unloading the wooden module #3 from the truck with mobile crane	Bumping, squeezing	Safety briefing, be outside of crane radius, minimum workers on site, wear PPE, use tools properly, clear communication
#8	Positioning the ground floor module (#3) on the foundation and fasten and connect it to the foundation and to wooden module #2	Bumping, squeezing, knocked by objects or tools, fall from ladder	Safety briefing, be outside of crane radius, minimum workers on site, wear PPE, use tools properly, clear communication
#9	Positioning and fastening of external staircase incl. technical room to foundation and wooden module #1	Bumping, squeezing, knocked by objects or tools	Safety briefing, be outside of crane radius, minimum workers on site, wear PPE, use tools properly, clear communication
#10	Positioning the arcade and fastening to wooden module #1 and #2	Bumping, squeezing, knocked	be outside of crane radius, minimum workers on site, wear PPE, clear communication
#11	Positioning the first floor modules (#4-#5) on the ground floor modules #1, #2 and fasten and connect them together	Bumping, squeezing, knocked by objects or tools	Unhurried working methods and clear communication, wear PPE, be outside of crane radius
#12	Building platform construction	Squeezing	Unhurried working methods and clear communication, wear PPE, use tools properly
#13	Electrical works	Danger of electrical accident	Only professionals, observe the 5 safety rules, wear PPE, safety briefing, proper tools, check equipment
#14	Sanitary works	Squeezing, injury due to sharp objects	Only professionals, proper tools, check equipment, wear PPE

5.12. Trades whose intervention is affected by risk prevention

Every levelup team member is under obligation to take part in health and safety training. The aim of participation is to inform and instruct participants clearly in order to guarantee safe construc-tion site operations. External partners and suppliers (such as logistics companies) are to be briefed by the team on construction site safety and receive all relevant information in advance. Entrance to the lot is only permitted after the health and safety briefings have taken place. Dan-gers are to be presented clearly and accident prevention regulations are to be explained. A Team Safety Officer will always be present during the assembly and disassembly phases and all working shifts. The official Health & Safety Team Coordinator inspects the construction site for occupational safety and health protection and coordinates compliance. A daily briefing takes place be-fore the start of each shift to inform others about upcoming tasks and hazards, as well as to in-form the team about health and safety issues. The Team Safety Officer works together with the Site Operations Coordinator (SOC) and will be required to identify and eliminate hazards. Both the The Team Safety Officer and the SOC are authorized to stop construction until these are eliminated if potential hazards arise.

5.13. Auxiliary resources planned for the construction

The levelup team will have the following auxiliary resources: a container with various bins for sep-arating waste. In addition, a container to store tools and personal equipment, the first aid ma-te-rial and fire extinguishers. A construction fence will surround and fence in the entire lot, securing it from external entry. In ad-dition, the team will use a mobile base tent, which provides shade and allows for short rests, and mobile lighting equipment. In addi-tion to housing drawings and plans, a folder with all important in-formation about health and safety will be located in the base tent. In addition, there are a variety of other tools that are used during the construction phase, which in-clude: ladders, electric screwdri-vers and drills, portable power tools, and are an example of the tools to be used during the assembly and disassembly of the HDU. All team members are to be trained on the use of these tools and equipment, and they must also ensure that they are in per-fect condition. Only materials and equipment that are in perfect con-dition are to be allowed on site. Tools must be properly cleaned up immediately after use. Ladders must be set up proper-ly.

The first aid kits on the lot have the following items (according to DIN 13169):

No.	Quantity	Item
#1	1	SÖHNGEN® Resuscitator
#2	4	PE pressure seal bag 300 x 400 x 0,05 mm
#3	2	SIRIUS® Rescue blanket (210 x 160 cm)
#4	1	DermaCare® compression bandage DIN small
#5	3	DermaCare® compression bandage DIN medium
#6	1	DermaCare® compression bandage DIN large
#7	1	Compression bandage cloth DIN SO 60 x 80 cm
#8	6	DermaCare® Compress separate 10 x 10 cm
#9	4	aluderm® bandage cloth 60 x 80 cm
#10	4	aluderm® compress separate 10 x 10 cm
#11	4	aluderm® eye compress DuOcul
#12	1	aluderm® compression bandage DIN small
#13	3	aluderm® compression bandage DIN medium
#14	1	aluderm® compression bandage DIN large
#15	4	WS fixation bandage 4 m x 6 cm
#16	4	WS fixation bandage 4 m x 8 cm
#17	1	Fleece cloths 100 x 300 mm á 5 pcs
#18	2	SÖHNGEN®-Pore 5 m x 2,50 cm
#19	2	aluderm®-aluplast Small assortment
#20	2	aluderm®-aluplast elastic first aid kit 80 x 6 cm
#21	1	Plaster dispenser aluderm®-aluplast
#22	4	Triangular cloth V pure white
#23	2	Glove set with 4 pieces vinyl large
#24	2	Instant cold compresses small 200 cm^2
#25	1	First aid dress scissors 19 cm knee arch st-st

5.14. Machinery planned for construction

The levelup team will have the following machines/equipment on site: mobile scaffolding, lifting platform, forklift truck and a mobile crane. The specifications for the above devices is not yet fixed as the final selection is still pending. The HS Team Coordinator and the Site Operations Co-ordinator must check the correct use of the aforementioned machines. The forklift truck, the lift-ing platform and mobile crane are only to be operated by trained, instructed and certificated crew members. Before each use, the machines/ equipment must be checked and the team mem-bers informed about possible risks. This includes checking the braking devices and the controls. The loads to be lifted must be securely fastened and the driveways on the construction site must be clear.

5.15. Construction site installations

In the course of the assembly and disassembly phases, various construction site installations are necessary, such as a water and power supply, or mobile lighting. Installation work must be con-ducted in such a way that personal injury and property damage are prevented. Electrical lines must be checked regularly for da-mage during construction. If problems arise, the SDE organiser must be contacted immediately.

5.16. Characteristics Table for the stocks

All building materials, tools, personal protective equipment and personal belongings are neatly stowed and stored in a construc-tion site container. All items must be returned to storage when not in use to prevent accidents.

6. Activities for risk prevention

Only the crew members who are actually needed for the construc-tion are allowed to be on the con-struction site. People without a task will not allowed to be on the lot. According to current plans, there will be a total of 30 crew members on the lot within two shifts a day, i.e. 15 crew members per shift (8 hours incl. breaks). Cons-truction site tasks that require professional experience and spe-cial training are to be outsourced to external partners (Contrac-ting). This includes tasks such as operating the construction site crane to lift the modules. Due to the modular timber construction and the high degree of prefabrication of the modules, incompa-tibilities and inconsistencies are not expected dur-ing assembly.
Additional information: Jewellery and long hair can get caught in construction machinery and cause life-threatening injuries. For this reason, jewellery, such as bracelets and necklaces, are not allowed on the construction site, and long hair must be plaited or tied back and secured. Work clothes must fit perfectly. Additional personal protective measures include sunshades and sunscreen, especially in hot weather during the summer months.

Before the competition phase in Wuppertal, several training sessions will be held at the university to inform the levelup team about accident prevention regulations and how to deal with hazards. Occu-pational safety experts will provide training on the following :

1) A first aid course and training:
The focus here is on the treatment of vital threats and trauma. This includes the stable side position, applying bandages and tourniquets, splinting fractures and even reanimation with an automated external defibrillator. In addition, the topics of wound care and hygiene are trained, and how to properly make emergency calls are also be practiced. In addition to the basic first aid topics, it is also very important to recognize medical emergencies and interpret them correctly.

2) Fire extinguisher training:
The aim of this training is to learn correct handling techniques with various types of fire extinguishers for different fire situations. In this context, there is a theoretical seminar and a practical exercise with a live fire situation, which is taught by an external fire safety officer.

3) Seminar on accident prevention regulations:
In this course all contents concerning safety measures and prevention regulations are trained. Train-ing materials from insurance companies are used for this purpose. The aim is to provide a gen-eral overview of all relevant topics and to train principles and behaviour in the event of accidents. This should also involve our partners with whom we are building our HDU.

4) Forklift course:
Individuals scheduled to be forklift truck drivers will all have valid driving licenses and will take part in a driving safety course before the competition . This will ensure safe and routine operation on the Solar Campus.

5) Manufacturer briefings:
Manufacturers will provide instruction on tools, machinery and equipment to ensure that these will be operated correctly. The work crew will be required to know the proper and accident-free operation of all equipment required for all phases of the competition.

7. Critical work phases for risk prevention

The main goal for every Team is that nobody will be injured during any phase of the competition. Therefore, every risk of injury must be eliminated or minimalized. To ensure this, all risks in the all processes need to be identified, and these need to be classified into categories. Based on these, solutions need to be found to minimize the risks for all of the team members. However, even after this part is completed, all team members are expected to abide by the rules and work in a careful and conscientious manner. You can find more information in our risk analysis plan.

8. Risk identification and efficacy evaluation of the adopted measures

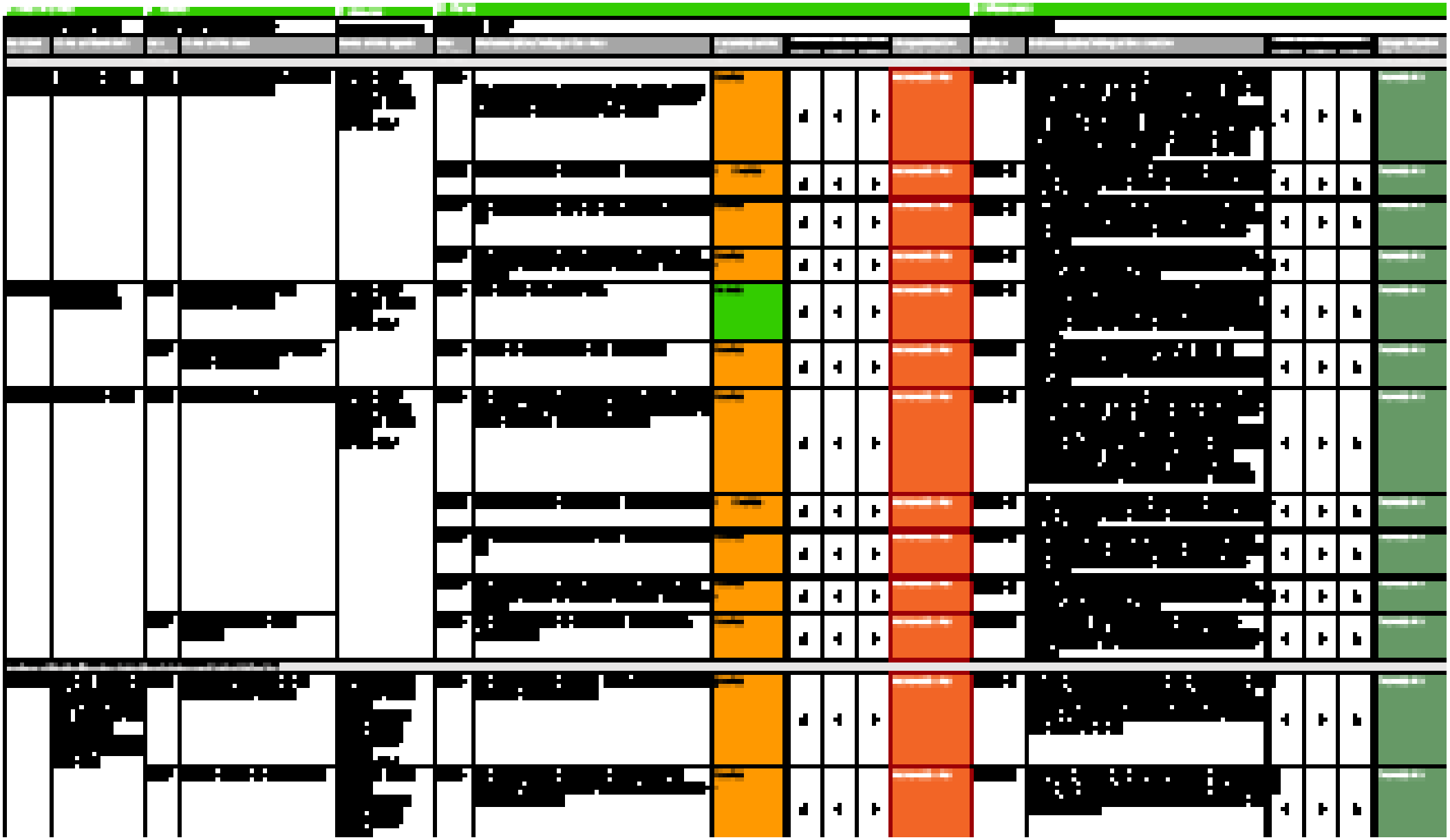
A detailed analysis can be found in the official Excel worksheet (ROS_HS#6_2021_12_01.xlsx) required for DEL#6, which identifies various dangers for different work steps assigned to active crew members. Risks are assessed and countermeasures are listed.
The worksheet can be found in the following pages:

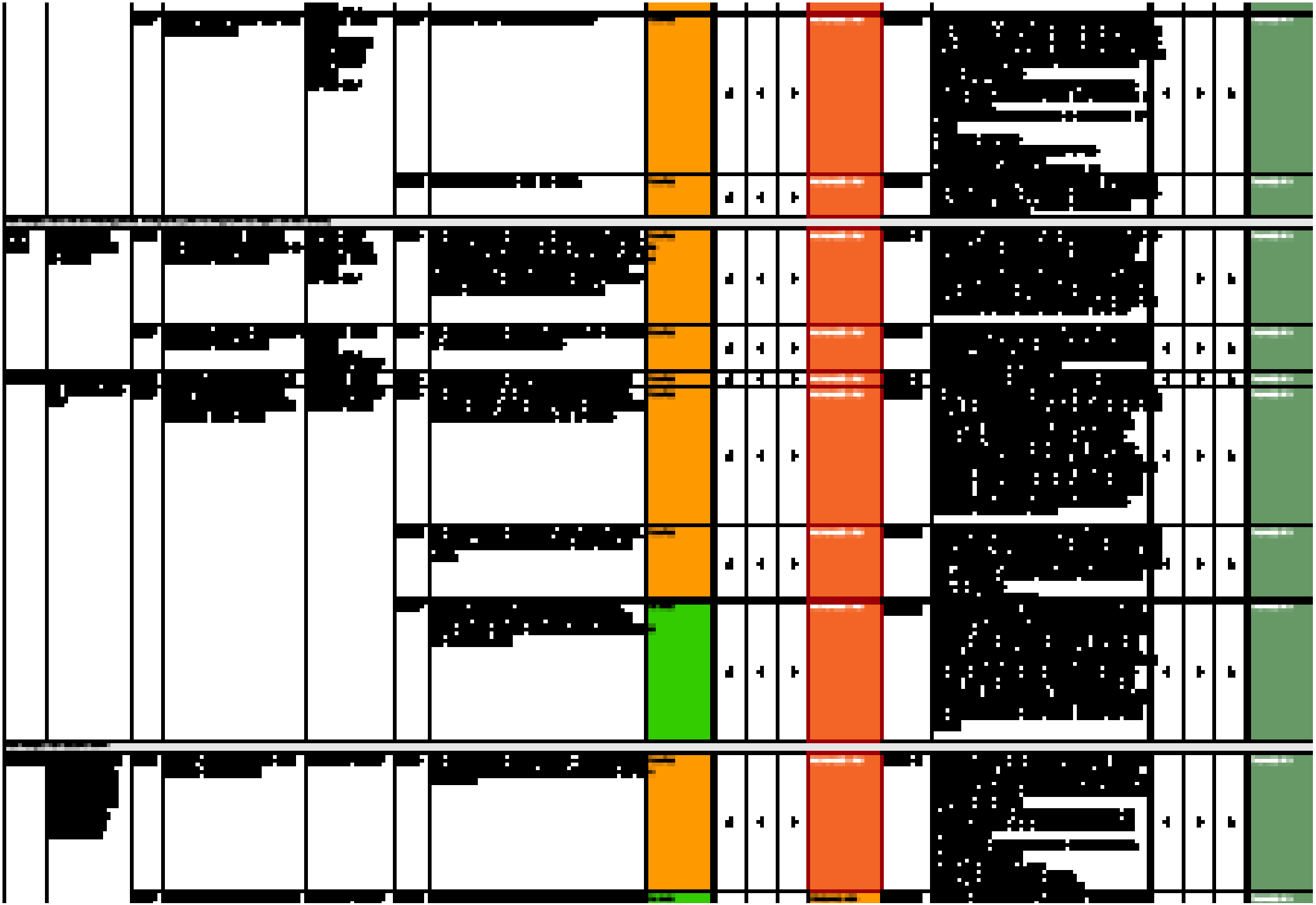
SDE 21_Health & Safety: Risk Analysis

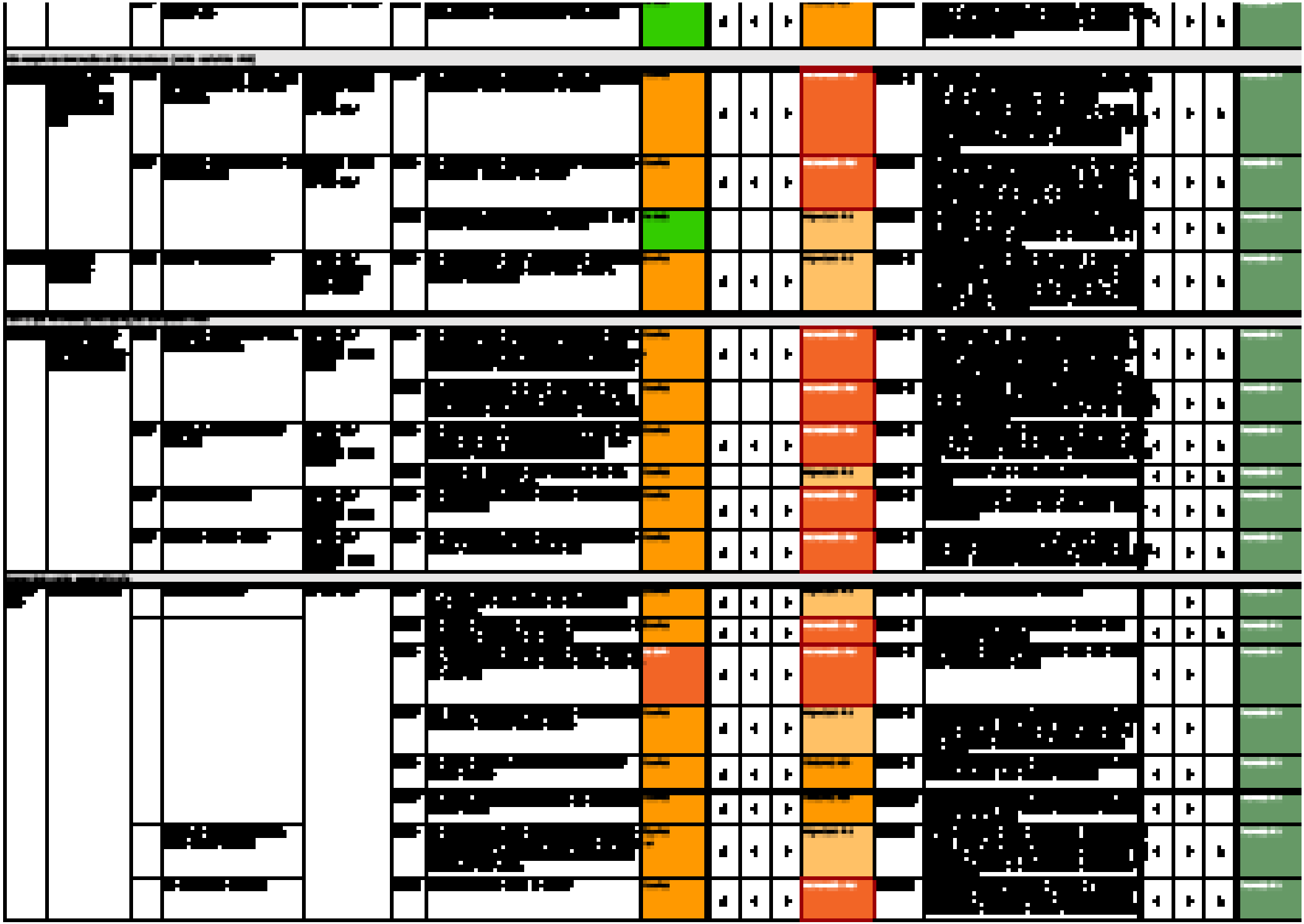
Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

L	Slight Injury	CP	Collective Protection
G	Serious Injury	IP	Individual Protection
Mo	Fatal Injury	S	Signs

NOTE: In this evaluation we consider “avoided risks” all qualified as “trivial” or „tolerable”; the rest of the qualifications are considered “not avoided risks” and need to be solved with further measures.







9. Collective protection utilization

Each crew member must be well prepared for the construction work, this contributes to collective protection. To ensure this, each team member is trained for their specific task. This ensures the high-est possible safety for the team and each worker.

The following courses have to be visited by all participants of levelup:

- Machinery course
- Health and safety training
- First aid course(s)
- Height activity and anti-fall guard training

Collective security arrangements include:

- Fire extinguisher(s) (DIN EN 3)
- Safety ladder(s)
- Tents used for sun shelter
- Site fence to prohibit access from unauthorized people onto the construction site
- Exit routes to assembly point
- Danger signs on the construction site
- Large lighting for work during the day and night
- Containers for storing work and personal items, in order to keep an organized and tidied work area

All hazards are marked according to DIN EN ISO 7010. A differentiation is made between rescue signs, prohibition signs, warning signs, mandatory signs and fire protection signs. Appropriate signs will be prominently displayed on the construction site in accordance with the regulations.

Necessary escape signs according to ASR A1.3 / ISO 7010

Relevant prohibition signs according to ASR A1.3 / ISO 7010

Relevant warning signs according to ASR A1.3 / ISO 7010

Relevant fire protection signs according to ASR A1.3 / ISO 7010

Mandatory sign according to ASR A1.3 / ISO 7010

All signs can be found in DIN EN ISO 7010.

10. Individual protection resources to use (PPE)

During the competition phase (assembly and disassembly), le-velup team members are under obliga-tion to wear prescribed Personal Protective Equipment (PPE), which must comply with European occupational health and safety requirements and SDE regulations. Many hazards and accidents can be avoided by wea-ring protective clothing and equipment, which explains the im-portance of using equipment that meets these requirements.

Certified work safety clothing consists of the following components:

- Safety helmet in reflective colours or luminous stripes (with neck guard depending on the work) (DIN EN 397)
- Safety boots with steel-toe cap and anti-slip sole (EN ISO 20345)
- Safety gloves with anti-slip coating (EN 420/388)
- Reflective jacket or high-visibility waistcoat (EN ISO 20471)
- Work trousers with knee pads and luminous stripes (DIN EN 14404), and team shirt

In addition, all members will wear additional personal protecti-ve equipment, as required:

- Safety googles, sunglasses (EN 166/170)
- Face shield
- Face mask (FFP2)
- Hearing protection (DIN EN 352) (DIN EN 352-2)
- Flashlights
- Respiratory protection (EN 140)

11. Safe working procedures of every team member

- During the assembly and disassembly phases, toilet facilities on the Solar Campus will be pro-vided by the organiser, as well as rest areas. Only individuals working on site are per-mitted to be on the construction site. Nevertheless, there is a small pavilion for short breaks. In addi-tion, the team will probably rent a flat as a base camp, which can also be used as a changing room, in the immediate vicinity of the Solar Cam-pus. There is a small mobile sink with soap on the lot and se-veral disinfection dispensers.

- The HS Team Coordinator and the Teams Safety Officers are responsible for ensuring that the terms of the health and sa-fety plan are met. All members of the team must agree to the regu-lations and must always adhere to them while working.

- Before team members start work, all workers must have read and understood the H&S plan. If members do not understand something, the Team Safety Officer need to explain it to them in detail until ambiguities are clarified.

- Nobody is allowed to stay on the site during any construction phase without proper PPE. Eve-ryone who takes part in the work must wear PPE, consisting of the items listed previously in Section 10. If individuals do not wear the required PPE, they must leave the work area and cannot return to it until they comply with the PPE regulations.

- Alcohol and drugs are strictly prohibited on the construction site and on the entire Solar De-cathlon competition grounds. Anyone who is caught under the influence must leave the con-struction site immediately and may only take part in the work until they are sober.

- Smoking is also prohibited, as it is not permitted on the entire SDE site. Anyone caught smok-ing during will be asked to put out their cigarette.

- If safety concerns arise, regardless of the area, these must be discussed with the Health & Safety officer, who must find a solution for the problem that has arisen. If they have troub-le doing this, they can involve the whole team. If the prob-lem cannot be solved, all work must be stopped for the time being, and the SDE officials must be informed.

- Before any construction begins, all persons involved must complete H&S training. This train-ing is very important to increase work safety and avoid injuries of any kind, because it demonstrates how to work according to the safety conditi-ons, how tools work, and what must be observed.

- All members who are to be involved in construction must also undergo a health examination by a doctor in order to check whether these individuals are suitable for their tasks.

- At least one Team Safety Officer must be present at each work shift to check current condi-tions on the construction site and, if necessary, make improvements. If this person cannot eliminate certain problems or hazards, they will notify the head HS Team Coordinator and the Site Operation Coordi-nator(s), who will then take further steps. A safety briefing is to be carried out before each shift to expose hidden dangers and to plan for their avoidance.

- Proper hygiene must always be observed. The entire work area must be well ventilated, lit and kept clean at all times. Every worker must have sufficient drinking water available.

12. Machinery and auxiliary resources

All individuals working with tools or equipment are to be briefed beforehand and must read the manufacturer‘s instructions. Working without instruction is not permitted. Only instructed and trained persons are allowed to operate the crane. It is important to point out that equipment must always remain in good and clean condition. All auxiliary equipment must be CE certified. All sharp objects such as saws, knives, drills, etc. must be covered so that no one can cut / hurt themselves. It is also important that all ladders are in good condition and have a firm footing. In general, it is im-portant to note that all equipment, tools and construction accessories are to be controlled before being brought onto the construction site and before use. Tools and equipment that are not in proper working order have no place on-site.

13. Planned measures in the case of an accident

In case of an accident, the HS Team Coordinator and Site Operation Coordinator must be informed immediately. Depending on the degree of injury, paramedics are to be called for, or the patient must be driven independently to hospital and accompanied by an additional person. Work-related acci-dents and injuries must be documented by a doctor, and this must be sent to the project manager, who will then forward the documents to the relevant department at the university. The university will immediately inform responsible insurance company(-ies) about the accident. The accident must also be recorded in the first-aid book. In addition to the medical certificate, the university must also fill out the official accident form, which contains the following information:

- Personal information of the injured person (given and surnames, date of birth)
- Date, time and location of the accident
- Detailed description of the accident
- Names of the persons involved in the accident/witnesses to the accident
- Type of injury
- Listing of (any) property damage
- Cause of accident
- Procedure after the accident / removal of dangers

The levelup team has one trained paramedic in our crew, and the other members are all trained in basic first aid measures. Two first aid bags shall be provided, one with basic equipment (according to DIN 13157) and one with advanced medical equipment. Material checklists are prepared for both first aid kits so that the material can be replenished easily.

Whether an automated external defibrillator will be available at the Solar Campus is still to be discussed with the SDE event organizer. The route from the solar campus to the Bethesda hospital can be found in the project drawings:

Agaplesion Bethesda Hospital Wuppertal
Hainstraße 35
42109 Wuppertal

14. Risk identification for construction-site work

A detailed analysis can be found in the section „Risk identification and efficacy evaluation of the adopted measures“. There is always a risk of personal injury on the construction site, especially when lifting and hoisting large loads. Accordingly, precautions must be taken to avoid accidents and per-sonal injury. In particular, risks are to be expected during timber construction work, when operating heavy equipment and during electrical installations. Due to the very high degree of prefabrication of the modules, risks can be reduced to a selective number of individual tasks. Minor work no longer needs to be done, as the modules only need to be put together like Lego building blocks.

15. Useful plans and information for health and safety

Every morning, before public tours begin, the team must clean and tidy up all rooms. It is important to remove splinters such as glass or wood, so that no injuries occur during the tours. All slippery areas must be dried or handled in such a way so that nobody slips and falls. This of course also has a posi-tive effect that all rooms and corridors look neat and well-kept, which in turn leaves a positive impres-sion on the visitors. Furthermore, similar work must take place on the exterior, where the HDU’s pe-rimeter must be kept clean and tidy and clear of garbage, like empty food and drink containers, etc. Puddles and excess dirt have to be removed.

Interior work to be done:
- All rubbish in the corridors and rooms are to be removed
- Broken objects are to be picked up with a vacuum cleaner
- Puddles are to be removed
- Dirt and dust is to be removed by a vacuum cleaner
- Fire extinguisher, safety equipment, etc. are to be in place
- First-aid kit(s) are to be checked for completeness

Exterior work to be done :
- Garbage which is lying around the house is to be collected
- Broken objects are to be removed
- Puddles are to be removed / filled
- Dirt is removed

Maintenance and checks must also be carried out at the HDU daily, such as:

- Cleaning and repairing of PV-panels to ensure the performance of the photovoltaic system
- Drainage holes and drains must be cleaned out, preventing blockage or flooding
- Water system maintenance
All necessary plans can be found in the project drawings.

16. Adopted system for the level of health and safety control during construction

One Team Safety Officer or the HS Team Coordinator, must be present at each work shift. This person is responsible for all work inside the fenced area, and for this reason they will constantly monitor and reassess the on-site situation. The levelup Team has also developed a Health & Safety control system. The HS Team Coordinator or a Team Safety Officer will be provided with multiple copies of a hazards evaluation chart on which hazards can be rated according to their severity, i.e.: ratings ranging from 0: 'No danger' to 4: 'High danger'. In combination with the construction schedule, the system is ac-complised using a checklist. This checklist must be signed and dated by each worker before their shift. The checklist contains points concerning: safe working procedures, formation and information on health and safety, PPE, and escape routes. Team members are required to tick off each individual point separately. The checklists are constantly kept with the Team Safety Officer. Before work com-mences, the Team Safety Officer and the Site Operations Coordinator must brief all crew members on their up-and-coming tasks and the associated risks. The HS Team Coordinator is responsible for or-ganizing all equipment and safety gear and checking these for their completeness and their condi-tion. Safety procedures are to be updated and briefed daily.

17. Formation and information about health and safety

Each team member must accept several rules before beginning their work processes. These are to be documented in writing and will have been made available to the organizer.
These are as follows:

- I have read the complete health and safety project manual, as well as all plans, and I agree to all of its contents.
- I have received all the training related to the collective protection, its correct application, and its maintenance procedure.
- I have received training to develop safe work practices and to avoid or solve the risks in-volved.
- I have passed specific medical examinations for the work to be performed, and have the nec-essary qualifications.
- I acknowledge the health and safety requirements of everyone involved in the project.
- I have received information about possible risks related to work.
- I commit to avoid or minimize the risks resulting from work processes.
- The Team levelup Rosenheim has informed me about the work / tasks that I am to perform.

18. Emergency Evacuation Plan during assembly and disassembly phases

In the event of fire or acute danger during all construction phases, it must be possible to immediately evacuate the House Demonstration Unit. In the event of an emergency occurring on site, properly placed and clearly signposted escape routes will assure a straightforward evacuation of the HDU and its lot. The HDU has short escape routes and large portals leading outside and directly to the assem-bly point. The assembly point is to be located at the entrance to the lot, and is to be signposted for all crew members to see. Furthermore, the escape route plans are to be signposted in prominent places near the HDU during all construction phases. The HDU will have two escape routes on the upper floor, one via the external staircase and the other via a ladder on the roof terrace. In the case of an evacuation, it is important that crew members assist one another, communicate with each other, stay calm and work together as a unit. It is imperative that no one be left behind in the HDU. To con-trol this the Team Safety Officer is to take a tally of all those present at the assembly point and report it to the HS Team Coordinator. It is of utmost importance that all team members do not re-enter the building until the HS Team Coordinator has given permission. Until then, a safety distance of 3 meters must be maintained. If there are any injured persons, they must be taken immediately to the exit and first aid must be administered. If their injuries are more serious, an ambulance and/or emergency doctor must be called.

46 Detailed Water Budget

Table of contents

SOLAR DECATHLON EUROPE 21/22 - Detailed Water Budget

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

Tank overview

Type of tank	Quantity [#]	Volume per tank [litre]	Volume total [litre]
Fresh water tank	3	410	1230
Waste water tank	1	400	400
Rainwater tank (optional)	6	115	690
Grey water tank (optional)	2	350	700
Other water usage (fill in below)			
			0
			0
			0
Total	12	1275	3020

Tank openings

Is there a central opening (no. = 1) or is it decentralised per tank (no. ≥ 2)?

	No. of openings [#]
Water Delivery	1
Water Removal	1

Water Delivery / Water Removal

	Water Delivery I	Water Delivery II Water Removal I	Water Delivery III Water Removal II	Water Removal III
	25. May 2022	03. June 2022	17. June 2022	27. June 2022
Fresh water delivery [litre]	1230	1230	1230	/
Waste water removal [litre]	/	400	400	400

More information about water consumption can be found in the Appendix - Detailed Water Budget

SOLAR DECATHLON EUROPE 21/22 - Detailed Water Budget - Example

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

Example

Tank overview

Type of tank	Quantity [#]	Volume per tank [litre]	Volume total [litre]
Fresh water tank	4	250	1000
Waste water tank	4	250	1000
Rainwater tank (optional)	2	300	600
Grey water tank (optional)	1	330	330
Other water usage (fill in below)			
			0
			0
			0
Total	11	1130	2930

Tank openings

Is there a central opening (no. = 1) or is it decentralised per tank (no. ≥ 2)?

	No. of openings [#]
Water Delivery	3
Water Removal	1

Water Delivery / Water Removal

	Water Delivery I	Water Delivery II Water Removal I	Water Delivery III Water Removal II	Water Removal III
	25. May 2022	03. June 2022	17. June 2022	27. June 2022
Fresh water delivery [litre]	1000	1500	1500	/
Waste water removal [litre]	/	1000	1500	2000

47 Electrical & PV Design Systems Information

Table of contents

electric and PV chart and checklists

contents

16.02.2021

solar decathlon europe 21

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electric and PV chart

and checklists

version 1.0

16_02_2021

Supported by:

Federal Ministry for Economic Affairs and Energy

on the basis of a decision by the German Bundestag

BERGISCHE UNIVERSITÄT WUPPERTAL

energy endeavour FOUNDATION

Other than described in the rules, the information about the technical components is requested in the SDE21_FACT_Project-Facts.

Accordingly, only the templates 'Electrical System Design Checklist', 'Photovoltaic Checklist' and 'Electrical Storage System Checklist' are provided here. The template 'Electrical and Photovoltaic Chart' is omitted.

These checklists are used to verify the requirements described in the Rules and in particular the Building Code.

To check the requirements, please describe the current status of implementation in the Comments column. In the Location column, please indicate in which documents and in which chapter the implementation is described technically. For drawings, please specify the file name of the drawing. And for certificates or attestations, please also indicate the respective file names.

contents

Electric System Design Checklist

Team ID	Team Name	Country
ROS	levelup	GER
	University	Date
	Technical University of Applied Sciences Rosenheim	22/03/27

Subject	Element	Required specification or information	Comment	Location PD sheet, PM Page or other documents
General Requirement	Electricity System	Technical products that are used in the House Demonstration Unit (HDU) must provide a safety level equivalent to European standard.	All devices used have a declaration of conformity.	See. → Project Specifications\Technical Building Services
		The electrical installations of the HDU must be planned properly by an installation designer and needs to be approved by a professional electrical engineer.	All electirical plans are check and signed by a professional eletircal engineer.	See. scan of plans BMS / ID / EL / PV
Electrical Grid	Low Voltage Distribution Network	Nominal voltage and frequency in the German Low Voltage distribution networks are: Voltage:400 V/230 V (phase-neutral). Frequency: 50 Hz.>Voltage band: 207 -253 V (normal operating range); >Frequency band: 49.5 -50.5 Hz (normal operating range).	All devices conform to the conditions of the ENTSO-E grid. The German grid voltages and frequencies were taken into account in the planning. The electrical engineering is based on these values.	See. → Project Specifications\Technical Building Services
		Overvoltage: equal or over 230 + 10% = 253 V; Undervoltage: equal or under 230 –10% = 207 V	All devices conform to the conditions of the ENTSO-E grid	See. → Project Specifications\Technical Building Services
		Overfrequency: equal or over 50 + 0.5 = 50.5 Hz; Underfrequency: equal or under 50 –0.5 = 49.5 Hz	All devices conform to the conditions of the ENTSO-E grid	See. → Project Specifications\Technical Building Services
	TN-C-S System	The cable connection of the HDU must be made according to the TN-C-S system, which is used in the German Low-Voltage Grid.	The requirements will be fulfilled.	EL-6004
		The TN system (French: terre neutre) is a certain type of implementation of a low-voltage grid in the electrical energy supply. The most important feature is the type of earth connection of this power supply system to the power source.	There will be a 5 pole cabel between the SDP and the general distribution box.	EL-6004
		Colour Code according to the international standard IEC 60446:	The requirements will be fulfilled.	See. EL - plans
	Utility Compatibility	The HDU needs to connect to the German Grid. If the Teams home country provides a different voltage, they have to announce this to the SDE21 Organisers.	Not necessary, as our devices comply with the German grid codes.	See. → Project Specifications\Technical Building Services

		Teams are responsible for the installation of an appropriate transformer, in case their HDU is built for a different voltage. The chosen fabricationneeds to be listed in the equipment listings.	Not necessary, as our devices comply with the German grid codes.	
		Devices in the house do not necessarily be compatible with the German Grid for the competition phase.	Not necessary, as our devices comply with the German grid codes.	
Safty Requirements	Short circuit protection	An automatic Residual Current Device (RCD) for personnel protection against indirect contact is needed.	Our installation will meet the required safety standards.	Check EL-6004, EL-6013, EL-6014, E-6015, EL-6018, EL-6019
		RCD prevents injuries caused by short circuits.	Our installation will meet the required safety standards.	Check EL-6004, EL-6013, EL-6014, E-6015, EL-6018, EL-6019
		A protection against contact of 30 milliamperes must be ensured.	There is a RCD type A (maximum fault current: 0.03 A, maximum tripping time: 200 ms) in the sub-distribution and in the meter cabinet. All circuits that lead to the consumers are protected by an RCD, which ensures personal protection. The circuit breakers were dimensioned accordingly for short-circuit protection. These activate the corresponding line in the event of a short circuit, which eliminates the risk of fire.	Check EL-6002, EL-6004, EL-6013, EL-6014, E-6015, EL-6018, EL-6019,EL-6025
		The RCD is mandatory in the fuse box of the HDU.	Our installation will meet the required safety standards.	EL-6004, EL-6013, EL-6014, EL-6015, EL-6018, EL-6019
	Earthing	An earthing-system is needed according to IEC 60364-5-54:2011.	The grounding is carried out via PE conductor in the supply line. An additional equipotential bonding is connected to a grounding plate which is bouried in the ground by the competition organizer. This is then connected to a main equipotential bonding bar in the technical modul room. The other outlets of the protective conductors for the distributions as well as for the equipotential bonding of the heating system are connected to this bar. There will be slave boundingbars in the near of appliances wich need to be connectet to the grounding system. Furthermore, all sockets contain the connection of a protective conductor. A separate earthing measurement via earthing probes provides information about the necessary low resistance of the protective conductor. This small resistance is necessary for the safe	EL-6001, EL-6005, EL-6010, EL-6023

		triggering of the fault protection switch.	
	Teams must provide equipotential bonding for each washing basin and bathtub and for all household appliances;	There are several equal bounding bars wich ware used to connect household applications to grounding.	EL-6001, EL-6005, EL-6010, EL-6023
	All conductors must be connected on a main equipotential bonding rail;	Our installation will meet the required safety standards.	EL-6001, EL-6005, EL-6010, EL-6023
	Connection to rod/ strip earth electrodes on the Teams lot which will be prepared by the SDE21 Organisers.	Our installation will meet the required safety standards.	EL-6001, EL-6004
Receptacles	All receptacles must have a building inspectorate approval. For that a CE marking is required.	Our receptacles will meet the standards.	See. → Project Specifications\Technical Building Services
	Any receptacles used must be protected with ground a residual current device (RCD). Enclosures provided must be suitable for damp locations (minimum IP44 protection level).	Our receptacles will have a minimum IP44 protection level and will meet the required safety standards. The sockets planned have building authority approval. They are 3-pole and protected with an RCD type A. Several electrical circuits ensure the perfect and simultaneous operation of the individual sockets.	See. → Project Specifications\Technical Building Services & EL-Plans
	Receptacles must be three-poled and have to be equipped with a child safety lock.	Our receptacles will be three-poled and are equipped with a child safety lock.	See. → Project Specifications\Technical Building Services & EL-Plans
	If a power connection is provided in the kitchen, it must be fused separately.	A separate power circuit will be provided and fused.	EL-6018
	For the heating test, a three-phase current socket (equipped for 5 kW) must be available in the house.	A 5-pin connector was provided for the hob in the kitchen. The heating measurement can then take place on this hob.	EL-6022
High Curren Power Connection	If there is a high current power connection (fixed connection) for the oven in the kitchen, it must be fused separately.	A separate power circuit will be provided and fused.	EL-6018
	Any other device with an output greater than 3.5 kW must also have a fixed connection.	Elevator, oven & stove have a fixed connection.	EL-6009, EL-6021
Exterior and Interior Lighting	In house tour areas, light fittings must provide a minimum illumination level of 20 lux for exterior path and traffic areas, and a minimum of 100 lux in average for interior areas. A minimum of 1 lux for all areas is required.	The requirements will be fulfilled. Extensive light simulations were carried out for this purpose.	
	Colour temperature of luminaires should be warm white (2700K-3000K) with a colour rendition Ra >80. Coloured lighting is prohibited in outdoor areas.	Only light sources that meet the requirements have been used.	

		The exterior and interior lighting design should minimize light pollution ("dark sky").	The requirements will be fulfilled.	
		Houses which have no or only inadequate external lighting on their lot, will be closed during evening hours.	The requirements will be fulfilled.	
Technical Requirements	Electricity Meter	Teams must provide an installation space for standardized electricity meters in the HDU. Four metering devices with separate wiring are expected to be installed in the HDU (sub-distribution, battery, PV and consumer meters). Dimensions and exact specifications will be provided on the SDE21 WAT.	obsolete with SDE21_Monitoring_Procedures_V3.0_21_02_22.pdf since all meters necessary for the project find place in the mp.	EL-6011
		Installation height: distance of meter niches from the surface of the finished floor (DIN 18013) > Upper edge max. 210 cm; > Lower edge min. 40 cm.	Thank you for the specifications, we will follow them.	ID-2002
		The cables are inserted vertically into the electricity meter from above or below.	The requirements will be fulfilled. The supply line is fed into the meter cabinet from below.	ID-2002
	Equipment Listings	All electrical equipment must be certified for the European market by complying with European standards and must bear a CE mark.	All devices are approved for the European market.	See. → Project Specifications\Technical Building Services
		All DC to AC utility-interactive inverters must be fully listed to European Standard.	All devices are approved for the European market.	See. → Project Specifications\Technical Building Services
	House Connection	Teams must provide an empty conduit with an outside diameter of 25 mm for the house connection of the HDU.	The cable can be led through a large opening in the floor	EL-1000

Photovoltaic Checklist

Team ID	Team Name	Country
ROS	levelup	GER
	University	Date
	Technical University of Applied Sciences Rosenheim	21/07/06

Subject	Element	Required specification or information	Comment	Location PD sheet, PM Page or other documents
General Requirement	Photovoltaic System Design	Particular attention should be paid to photovoltaic system design, storage batteries, generators, grounding, conductors for general wiring, flexible cords and cables, and over-current protection devices, respectively.	We plan and work according to the current state of the art.	PV-2001
		photovoltaic system design	✓	PV-2001
		storage batteries	✓	PV-2001 Data sheet of BYD Batteriebox
		generators	✓	PV-2001 Data sheet of Dual Sun Spring 375 Shingle Black
		grounding	✓	PV-4001
		conductors for general wiring	✓	EL-2001
		flexible cords and cables	✓	EL-2001
		over-current protection devices	✓	PV-2001
	Regulation Compliance	**In order to verify the regulation compliance, Teams must complete and submit these "Photovoltaic Checklist".**	✓	
Safety Requirements	Emergency Switch The photovoltaic system shall include the following protectio	A general emergency switch for DC current must be set up close to photovoltaic system, and remote controlled from electric box of the house, near to the house general circuit breaking system.	Is planned and provided.	EL-6013, EL-6024
		The general emergency switch must provide the isolation level	This requirement will be fulfilled.	See. → Project Specifications\Technical Building Services

	n devices at the utility interface :	required by the German Regulation.		
		This switch will be accessible to the electricity distribution company in order to be able to perform a safe manual disconnection of the photovoltaic system.	Confirmed. Is located near the main distribution	EL-6013, EL-6024
	Earthing	Earthing of the photovoltaic system equipment shall be done without disturbing the earthing of the utility distribution system, ensuring that no defects are transferred to the distribution network. See Rule 50.5 for Ground Penetration limits.	Confirmed and the rule will be followed.	EL-6001, EL-6023, EL-6028
		The photovoltaic system shall guarantee galvanic separation between the Low Voltage distribution network and the photovoltaic system, by means of an isolation transformer (included in or external to the inverters) or by any other means fulfilling the same function, based on state-of-the-art technological development.	Confirmed delivery of the inverter from Fronius: Fronius Symo GEN24 3.0 plus The required certificate is available from Fronius.	See. → Project Specifications\Technical Building Services
		In this sense, inverters with high-frequency transformers or transformer less inverters are permitted, provided that the inverter(s) manufacturer(s) provides a certificate guaranteeing that the maximum DC current to be fed into the grid is smaller or equal than 0.5% of the nominal output current of the device(s).	Confirmed delivery of the inverter from Fronius: Fronius Symo GEN24 3.0 plus The required certificate is available from Fronius.	See. → Project Specifications\Technical Building Services
		Teams must include in the project documents certificates of the inverters manufacturers that demonstrate compliance with the galvanic separation	Confirmed delivery of the inverter from Fronius: Fronius Symo GEN24 3.0 plus The required certificate is available from Fronius.	See. → Project Specifications\Technical Building Services

		requirement as well as with other requirements of the German Regulations mentioned in Rule 50.2 (for example, protections against over/under voltage and frequency).		
	Equipment Listings	Unlisted PV modules may be used in a system with a DC bus voltage of no greater than 60 volts (open circuit) at 0 °C if, and only if, such equipment has been evaluated and approved by the Solar Decathlon Europe 2021 Building Official and Solar Decathlon Europe 2021 electrical inspectors. PV cell and module mounting means are subject to increased scrutiny in custom made, unlisted, building-integrated PV applications.	The current configuration is available on the market. PVT-Modul SPRING 375 Shingle Black	See. → Project Specifications\Technical Building Services
		The use of unlisted PV modules and the installation of listed PV modules in an unapproved manner in a system with a DC bus voltage of greater than 60 volts (open-circuit) at 0 °C are prohibited. Listings shall be to European Standards and shall be granted by an approved, accredited testing laboratory (e.g. German TÜV).	The current configuration is available on the market. PVT-Modul SPRING 375 Shingle Black	See. → Project Specifications\Technical Building Services
		The attachment of PV modules to any material where the PV module is not listed for such an application is prohibited, regardless of the bus voltage.	This requirement will be fulfilled.	See. → Project Specifications\Technical Building Services
Technical Requirements	Grid Interconnection	The Photovoltaic system will be connected to the electricity distribution network following a single-phase configuration (connection to the phase and neutral) or a three-phase configuration for huge systems.	For reasons of phase symmetry, we are planning a three-phase-configuration.	PV-2001

	The interface between the Photovoltaic system and the electricity distribution network shall comply with the international standard IEC 61727 – Photovoltaic (PV) systems – Characteristics of the utility interface.	This requirement will be fulfilled.	EL-6023
	IEC 61727 regulates the grid interconnection of low-power electricity generation installations Photovoltaic systems up to 100 kW to Low Voltage electricity distribution networks.	This requirement will be fulfilled.	follows
	PV DC cables remain at exterior of the house as most as possible, and then enter directly in mechanical room. In the best case, inverters are positioned at exterior, on house roof. In other cases, PV DC cables remain only in mechanical room, in a protected path. This path must resist during 30 minutes to the fire.	Inverter is outside.e	EL-6023
Inverters	A circuit breaking system is installed to switch off simultaneously all inverters. This inverters emergency circuit breaking system will be visible, near to house general circuit breaking system, and these two general switches must be identified by quoting: «Warning: presence of tension sources: 1- Distribution grid 2- Photovoltaic panels», in black letter with yellow background. Furthermore, a pictogram representing photovoltaic risk must be indicated at exterior of the house,	This requirement will be fulfilled.	EL-6013

		on mechanical room door.		
	Over / under Voltage and Frequency	The photovoltaic system shall disconnect from the utility system (grid) whenever voltage or frequency are outside the specified ranges. To this aim, an automatic switch will be used to guarantee protection against over/under voltage and frequency. This switch can be integrated in the inverter, in which case it shall comply with the German Low Voltage Electric-Technical Regulation.	Confirmed delivery of the inverter from Fronius: Fronius Symo GEN24 3.0 plus See conformation in in folder →	See. → Project Specifications\Technical Building Services

Photovoltaic system drawings

- Teams must complete the drawings according to the specifications given below.
- Drawings reference numbers shown below indicate the minimum drawings required for approval. Additional drawings can be included, provided that they respect the corresponding section, for example: for particular details of the complete PV system, new drawings with reference numbers PV-11 to PV-19 can be added. The same applies for details of the DC circuits (new drawings: PV-21 to PV-29), AC circuits (PV-21 to PV-29) and Grounding system (PV-41 to PV-49)

PV-10	**Photovoltaic system: General** This drawing shall be electrical and include the interfaces with the electrical installation of the house and the electricity distribution network	Team SDE	levelup
PV-20	**Photovoltaic system: DC circuits** This drawing shall be electrical and include information about wiring (section, type), protections (current characteristics) and wiring methods of DC circuits	Team SDE	levelup
PV-30	**Photovoltaic system: AC circuits** This drawing shall be electrical include information about wiring (section, type), protections (current characteristics) and wiring methods of AC circuits	Team SDE	levelup
PV-40	**Photovoltaic system: Grounding system** This drawing shall include information about wiring (section, type) and wiring methods of the grounding system, including DC and AC circuits	Team SDE	levelup

Electrical Storage System Checklist

Team ID	Team Name	Country
ROS	levelup	GER
	University	Date
	Technical University of Applied Sciences Rosenheim	21/03/16

Subject	Element	Required specification or information	Comment	Location PD sheet, PM Page or other documents
General Requirements	Inverter	The inverter to be used together with the battery bank must be designed for operation in a grid type TN-C-S This characteristic will be properly justified in the corresponding technical document.	Confirmed delivery of the inverter from Fronius: Fronius Symo GEN24 3.0 plus See conformation in in folder →	See.. → Project Specifications\Technical Building Services
			Confirmed delivery of the inverter from Fronius: Fronius Symo GEN24 3.0 plus See conformation in in folder →	See.. → Project Specifications\Technical Building Services
	Batteries	With respect to the conditions during the competition weeks and the measured Contest the maximal usable storage capacity of the battery bank is 2,5kWh	Current planning with the unit: Battery box Premium HVS from BYD. The unit has a capacity of 2.5 kWh. See conformation in in folder →	See.. → Project Specifications\Technical Building Services

48 Project Specifications

Table of contents

SDE 21_Project Specifications: Architectural Elements

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

Architectural Elements

Category	Document Name	GuID (BIM)
Category definitions (see Categorization Guideline)	*Team ID_Abbreviation_Product or Material_maufacturer.pdf when used more than once: Team ID_Abbreviation_Product or Material_maufacturer_01.pdf*	*Element ID according to your BIM Model*
01_Construction materials		
CONS *(Construction materials)*	ROS_CONS_Post girder_Pitzl	+C10107AB1#322=UL%1
		+C10107A01#390%1
		+C10107AB1#390%1
		+C10107A01#390%2
		+C10107A01#390%2
	ROS_CONS_Structural connector_Rothoblaas_03	+C10107A01#390%3
		+C10107AB1#390%3
	ROS_CONS_Structural connector_Rothoblaas_04	+C10107AB1#390%4
	ROS_CONS_Structural connector_Rothoblaas_05	+C10107AB1#390%5
	ROS_CONS_Structural connector_Rothoblaas_06	+C10107AB1#390%6
	ROS_CONS_Structural connector_Rothoblaas_07	+C10107A01#390%7
	ROS_CONS_Structural connector_Rothoblaas_08	+C10107A01#390%8
	ROS_CONS_Structural connector_Rothoblaas_09	+C10107A00#390%9
		+C10107A01#390%9
	ROS_CONS_Structural connector_Rothoblaas_10	+C10107A01#390%10
		+C10107A00#390%10
	ROS_CONS_Structural connector_Rothoblaas_11	+C10107A01#390%11
	ROS_CONS_Structural connector_Rothoblaas_12	+C10107AB1#390%12
		+C10107A01#390%12
02_Cladding material		
CLAD *(Cladding material)*	ROS_CLAD_Claybuildingpanel_Claytec	
	ROS_CLAD_ResystaPanel.PNG	
	ROS_FP_BE.YOND_swisskrono.pdf	
03_Construction boards		
BRD *(Construction boards)*	ROS_BRD_battens_Proebstl.pdf	
04_Thermal Insulation		
THI *(Thermal Insulation)*	ROS_THI_STEICOflex.pdf	
	ROS_THI_STEICOprotectHdry_Steico.pdf	
	ROS_THI_STEICOwall_Steico.pdf	
	ROS_THI_STEICOzell_Steico.pdf	
	ROS_FP_GUTEXStandardN.pdf	
	ROS_FP_GUTEXThermowall.pdf	

05_Waterproofing		
WPR *(Waterproofing)*		
06_Facade materials		
FCD *(Facade materials)*	ROS_FCD_3layerboard_Proebstl.pdf	
07_Openings		
OPN *(Openings)*		
08_Ceiling and Flooring		
CEFL *(Ceiling and Flooring)*	ROS_CFEL_GUTEXStandardN	
	ROS_CFEL_GUTEXThermowall	
	ROS_CFEL_HAROparquet	
	ROS_CFEL_KVH_bestwoodSchneider	
	ROS_CFEL_Lignodecke_Lignotrend_01	
	ROS_CFEL_Majrex200_SIGA	
	ROS_CFEL_Majvest700SOB_SIGA	
09_Furnishing		
FUR *(Furnishing)*		
10_Others		

OTH *(Others)*		

SDE 21_Project Specifications: Technical Building Services

Deliverable No.	D#6
Team ID	ROS
University/ City	Rosenheim

Technical Building Services

Category	Document Name
Category definitions (see Categorization Guideline)	*Team ID_Abbreviation_Product or Material_maufacturer.pdf* *when used more than once:* *Team ID_Abbreviation_Product or Material_maufacturer_01.pdf*
01_Elevator	
ELV *(Elevator)*	ROS_ELV_Lift_Cibes_01.pdf
	ROS_ELV_Lift_Cibes_02.pdf
	ROS_ELV_Lift_Cibes_03.pdf
	ROS_ELV_LiftConformity_Cibes.pdf
02_Plumbing	
PL *(Plumbing)*	ROS_PL_FreshWaterPump_Grundfos_01.pdf
	ROS_PL_FreshWaterPump_Grundfos_02.pdf
	ROS_PL_FreshWaterPumpConformity_Grundfos.pdf
	ROS_PL_FreshWaterStation_Oventrop.pdf
	ROS_PL_FreshWaterStationConformity_Oventrop.pdf
	ROS_PL_GreyWaterTreatment_Intewa.pdf
	ROS_PL_GreyWaterTreatmentConformity_Intewa.pdf
	ROS_PL_PVTPump_Grundfos.pdf
	ROS_PL_PVTPumpConformity_Grundfos.pdf
	ROS_PL_SewagePumpStation_Sulzer.pdf
	ROS_PL_ShowerChannel_Joulia.pdf
	ROS_PL_FlatTankWastewater_Tanksdirekt.pdf
	ROS_PL_FlatTankFreshwater_Tanksdirekt.pdf
	ROS_PL_ShowerMixer_HANSA.pdf
	ROS_PL_WastewaterPipe_Geberit.pdf
03_Electrical	
	ROS_EL_CompactSwitch3P_Hager.pdf
	ROS_EL_CompactSwitch4P_Hager.pdf
	ROS_EL_Conformity_Hager.pdf
	ROS_EL_Conformity_MDT.pdf
	ROS_EL_DCConverter_Wago.pdf
	ROS_EL_DimmingActuator_MDT_01.pdf

EL *(Electrical)*	ROS_EL_EnOceanGatewayConformity_Weinzierl.pdf
	ROS_EL_EnOeanTransmitter1gang_Gira.pdf
	ROS_EL_EnOeanTransmitter1gangConformity_Gira.pdf
	ROS_EL_EnOeanTransmitter2gang_Gira.pdf
	ROS_EL_EnOeanTransmitter2gangConformity_Gira.pdf
	ROS_EL_G1_Gira.pdf
	ROS_EL_InsertNetworkConnection1gang_Gira.pdf
	ROS_EL_InsertNetworkConnection2gang_Gira.pdf
	ROS_EL_JalousieEngine_Warema.pdf
	ROS_EL_JalousieEngineConformity_Warema.pdf
	ROS_EL_KnxCable_Hager.pdf
	ROS_EL_KnxIpRouter_Gira.pdf
	ROS_EL_KNXOvervoltageProtection_OBO.pdf
	ROS_EL_KNXOvervoltageProtectionConformity_OBO.pdf
	ROS_EL_LineCoupler_MDT.pdf
	ROS_EL_MCB_ABB.pdf
	ROS_EL_MCBConformity_ABB.pdf
	ROS_EL_MotionDetector_Nodon_01.pdf
	ROS_EL_MotionDetector_Nodon_02.pdf
	ROS_EL_MotionDetectorConformity_Nodon.pdf
	ROS_EL_OelflexCable_LappKabel.pdf
	ROS_EL_OvervoltageProtection_OBO_01.pdf
	ROS_EL_OvervoltageProtection_OBO_02.pdf
	ROS_EL_OvervoltageProtectionConformity_OBO_01.pdf
	ROS_EL_OvervoltageProtectionConformity_OBO_02.pdf
	ROS_EL_PowerSupply_Wago.pdf
	ROS_EL_PowerSupplyConformity_Wago.pdf
	ROS_EL_RCBO_ABB.pdf
	ROS_EL_RCBOConformity_ABB.pdf
	ROS_EL_RCCBTypA_ABB.pdf
	ROS_EL_RCCBTypAConformity_ABB.pdf
	ROS_EL_RCCBTypB_ABB.pdf
	ROS_EL_RCCBTypBConformity_ABB.pdf
	ROS_EL_RelaisModul_Wago.pdf
	ROS_EL_RemoteControll_Eltako.pdf
	ROS_EL_RJ45OvervoltageProtection_OBO.pdf
	ROS_EL_RJ45OvervoltageProtectionConformity_OBO.pdf
	ROS_EL_RoomTemperatureHumiditySensor_MDT.pdf
	ROS_EL_RouterFritzBox_AVM.pdf
	ROS_EL_RouterFritzBoxConformity_AVM.pdf
	ROS_EL_ShutterActuator_MDT_01.pdf
	ROS_EL_SmartMeter_Fronius_01.pdf
	ROS_EL_SmartMeterConformity_Fronius.pdf
	ROS_EL_SocketOutlet_Gira.pdf
	ROS_EL_Switch_Zyxel.pdf
	ROS_EL_SwitchActuator_MDT_01.pdf
	ROS_EL_SwitchConformity_Zyxel.pdf

	ROS_EL_WeatherStation_MDT.pdf
	ROS_EL_X1_Gira.pdf
	ROS_EL_Controller_Wago_001.pdf
	ROS_EL_Light RIBAG DB Vertico Pendel.pdf
	ROS_EL_Light_SORAA SM16GW 7.5W VIVID.pdf
	ROS_EL_Light_TobiasGrau DB_SALT & PEPPER.pdf
	ROS_EL_Light_prediger uma-soundlaterne.pdf
04_HVAC	
HVAC *(HVAC)*	ROS_HVAC_Battery_BYD.pdf
	ROS_HVAC_CO2Sensor_Belimo_01.pdf
	ROS_HVAC_CO2Sensor_Belimo_02.pdf
	ROS_HVAC_CO2SensorConformity_Belimo.pdf
	ROS_HVAC_DifferencePressureSensor_Belimo_01.pdf
	ROS_HVAC_DifferencePressureSensor_Belimo_02.pdf
	ROS_HVAC_DifferencePressureSensorConformity_Belimo.pdf
	ROS_HVAC_EnergyValveEV015R3_Belimo.pdf
	ROS_HVAC_EnergyValveEV015R3Conformity_Belimo.pdf
	ROS_HVAC_EnergyValveEV025R2_Belimo.pdf
	ROS_HVAC_EnergyValveEV025R3_Belimo.pdf
	ROS_HVAC_EnergyValveEV025R3Conformity_Belimo.pdf
	ROS_HVAC_Heatpump_Ecoforest.pdf
	ROS_HVAC_HeatpumpConformity_Ecoforest.pdf
	ROS_HVAC_Pump_Grundfos.pdf
	ROS_HVAC_PumpConformity_Grundfos.pdf
	ROS_HVAC_RotaryActuatorSR24A_Belimo.pdf
	ROS_HVAC_RotaryActuatorSR24AConformity_Belimo.pdf
	ROS_HVAC_ValveDrive_Oventrop.pdf
	ROS_HVAC_ValveDriveConformity_Oventrop.pdf
	ROS_HVAC_Ventilation_Maico.pdf
	ROS_HVAC_RadiantHeatingFloor_Lindner.pdf
	ROS_HVAC_BufferTankHeatingCooling_Sailer.pdf
	ROS_HVAC_BufferTankPortableWaterHot_Sailer.pdf
	ROS_HVAC_VentilationConformity_Maico.pdf
05_Fire Protection	
	ROS_FP_3layerboard_Proebstl.pdf
	ROS_FP_battens_Proebstl.pdf
	ROS_FP_BE.YOND_swisskrono.pdf
	ROS_FP_KVH_bestwoodSchneider.pdf
	ROS_FP_claypanelReport.pdf
	ROS_FP_GUTEXStandardN.pdf
	ROS_FP_GUTEXThermowall.pdf
	ROS_FP_H05RN-F.PNG
	ROS_FP_H05VV-F.PNG
	ROS_FP_HAROparquet.pdf
	ROS_FP_HCAT7H234P.pdf
	ROS_FP_J-Y(ST)Y.PNG
	ROS_FP_KVH_bestwoodSchneider.pdf

FP *(Fire Protection)*	ROS_FP_LemixD16.pdf
	ROS_FP_Lignodecke_Lignotrend_01.pdf
	ROS_FP_Majrex200_SIGA.pdf
	ROS_FP_Majvest700SOB_SIGA.pdf
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	ROS_FP_NYM-J.PNG
	ROS_FP_Post girder_Pitzl.pdf
	ROS_FP_ResystaPanel.PNG
	ROS_FP_SmokeAlarm_Gira.pdf
	ROS_FP_STEICOflex.pdf
	ROS_FP_STEICOLVL_Steico.pdf
	ROS_FP_STEICOprotectHdry_Steico.pdf
	ROS_FP_STEICOwall_Steico.pdf
	ROS_FP_STEICOzell_Steico.pdf
	ROS_FP_WirelessModule_Gira.pdf
06_Solar systems and PV	
SWPV *(Solar systems and PV)*	ROS_SWPV_PVT_Dualsun_01.pdf
	ROS_SWPV_FacadePV_Sunovation_01.pdf
	ROS_SWPV_semitransparentPV_Sunovation_01.pdf
	ROS_SWPV_Battery_Conformation of capacity_BYD.pdf
	ROS_SWPV_HelpSwitch_Eaton.pdf
	ROS_SWPV_HelpSwitchConformity_Eaton.pdf
	ROS_SWPV_Inverter_Fronius.pdf
	ROS_SWPV_InverterConformity_Fronius.pdf
	ROS_SWPV_OvervoltagePortection_OBO.pdf
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	ROS_SWPV_StringSafetySwitchPVConformity_Eaton.pdf
	ROS_SWPV_UndervoltageRelease_Eaton.pdf
	ROS_SWPV_UndervoltageReleaseConformity_Eaton.pdf
07_Appliances	
APPL *(Appliances)*	ROS_APPL_Dishwasher_NEFF_01.pdf
	ROS_APPL_Dishwasher_NEFF_02.pdf
	ROS_APPL_Dishwasher_NEFF_03.pdf
	ROS_APPL_DishwasherConformity_NEFF.pdf
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	ROS_APPL_FridgeFreezerConformity_Siemens.pdf

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	ROS_APPL_Oven_Bosch_02.pdf
	ROS_APPL_Oven_Bosch_03.pdf
	ROS_APPL_OvenConformity_Bosch.pdf
	ROS_APPL_Stove_Siemens_01.pdf
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	ROS_APPL_WashingMachine_Bosch_01.pdf
	ROS_APPL_WashingMachine_Bosch_02 pdf
	ROS_APPL_WashingMachine_Bosch_03.pdf
	ROS_APPL_WashingMachineConformity_Bosch.pdf
08_Vehicles	
VEH *(Vehicles)*	ROS_VEH_CargoBike_ JohanssonBikes.pdf
	ROS_VEH_InstruktionManualCargoBike_ JohanssonBikes.pdf
09_Others	
OTH *(Others)*	

GuID (BIM)
Element ID *according to your BIM Model*
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+C10107AB1#410%3
+C10107A01#410%2
+C10107AB1#410%1
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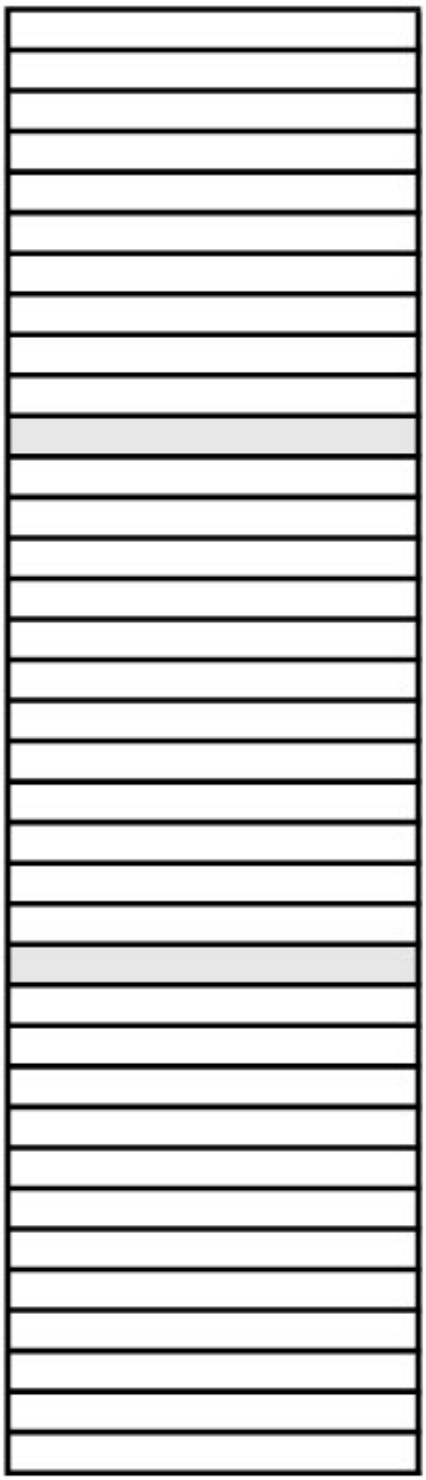


49 Structural Calculations

Table of contents

structural overview

Structural Report

The brief report contains:

- Structural Calculation (calculations need to be comprehensible and verifiable);
- Structural Drawings (part of Project Drawings (PD, each individual Structural Drawing needs to be proofed and stamped in green colour).

TABLE 1. STRUCTURAL REPORT TABLE

Overview of structural report			
1 Structural Calculation			
Title of document	Version	Date	Pages Count
Tragwerksplanung: Genehmigungsplanung Zugangskonstruktion HDU Solar Decathlon	08.03 2022	1	208 Pages
Tragwerksplanung: Ausführungsplanung HDU Solar Decathlon Europe 21/22	08.12 2021	1	39 Pages
Baustatik Stahlbau SDE21_22 HDU Genehmigung	23.03 2022	1	15 Pages
Zugangskonstruktion Genehmigung Tragwerksplanung	08.03 2022	1	
2 Structural Drawings			
Title of drawing	Version	Date	Pages Count
ST-1001 - ST-1002	1	28.03.22	2
ST-1101 - ST-1107	1	28.03.22	7
ST-1201 - ST-1202	1	28.03.22	2
ST-1301	1	28.03.22	1
Grundriss 0.00 (Stahlbau)	1	24.03.22	1
Grundriss +3.972 (Stahlbau)	1	24.03.22	1
Achsenschnitt (Stahlbau)	1	24.03.22	1
Längsschnitt (Stahlbau)	1	24.03.22	1
Treppe (Stahlbau)	1	24.03.22	1
Gitterroste (Stahlbau)	1	24.03.22	1
Geländerausführung (Stahlbau)	1	24.03.22	1
Perspektiven Stahlbau	1	24.03.22	1

Appendix

01 Appendix

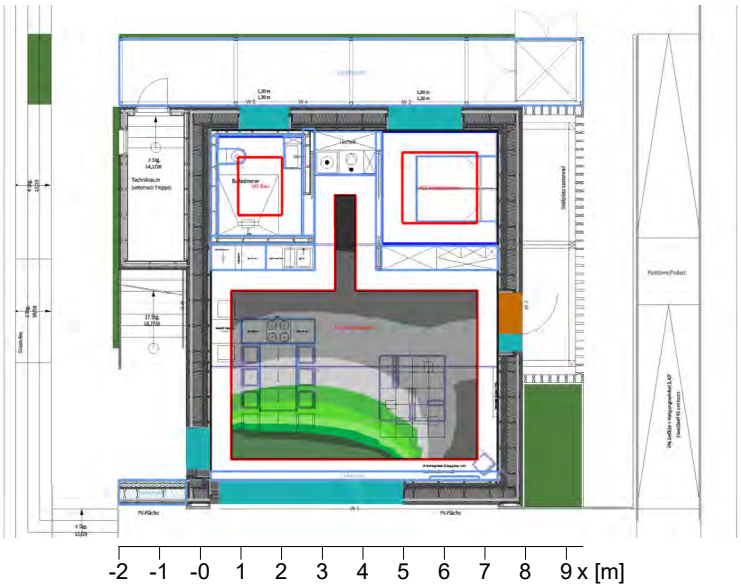
Architecture Design Report

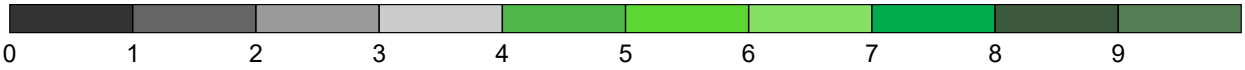
Objekt : HDU
Anlage :
Projektnummer : Lichtplanung
Datum : 31.10.2021

1 Raum 1

1.1 Zusammenfassung, Raum 1

1.1.1 Ergebnisübersicht, M1 Wohnbereich





Tageslichtquotient [%]

Allgemein

Verwendeter Rechenalgorithmus	hoher Indirektanteil
Höhe der Bewertungsfläche	0.90 m
Verwendeter Rechenmodus	CIE bedeckt. Himmel
Datum, Uhrzeit:	21.03. 10:28 (WOZ 09:49)

Geographische Daten:

Standort	: Wuppertal
Breitengrad	: 51.27 °
Längengrad	: 7.05 °
Nordwinkel	: 27.00 °

Tageslichtquotient

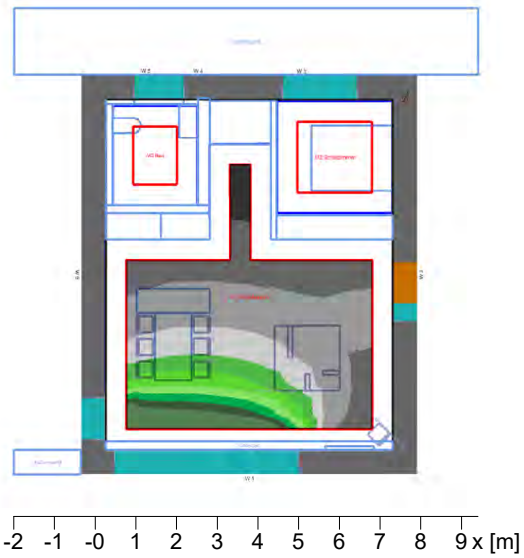
Mittlerer Tageslichtquotient	Dm	: 3.23
Minimaler Tageslichtquotient	Dmin	: 0.62
Maximaler Tageslichtquotient	Dmax	: 9.66

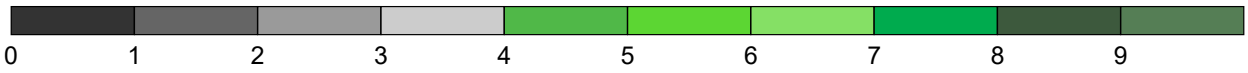
Objekt : HDU
Anlage :
Projektnummer : Lichtplanung
Datum : 31.10.2021

1 Raum 1

1.1 Zusammenfassung, Raum 1

1.1.1 Ergebnisübersicht, M1 Wohnbereich





Tageslichtquotient [%]

Allgemein

Verwendeter Rechenalgorithmus	hoher Indirektanteil
Höhe der Bewertungsfläche	0.90 m
Verwendeter Rechenmodus	CIE bedeckt. Himmel
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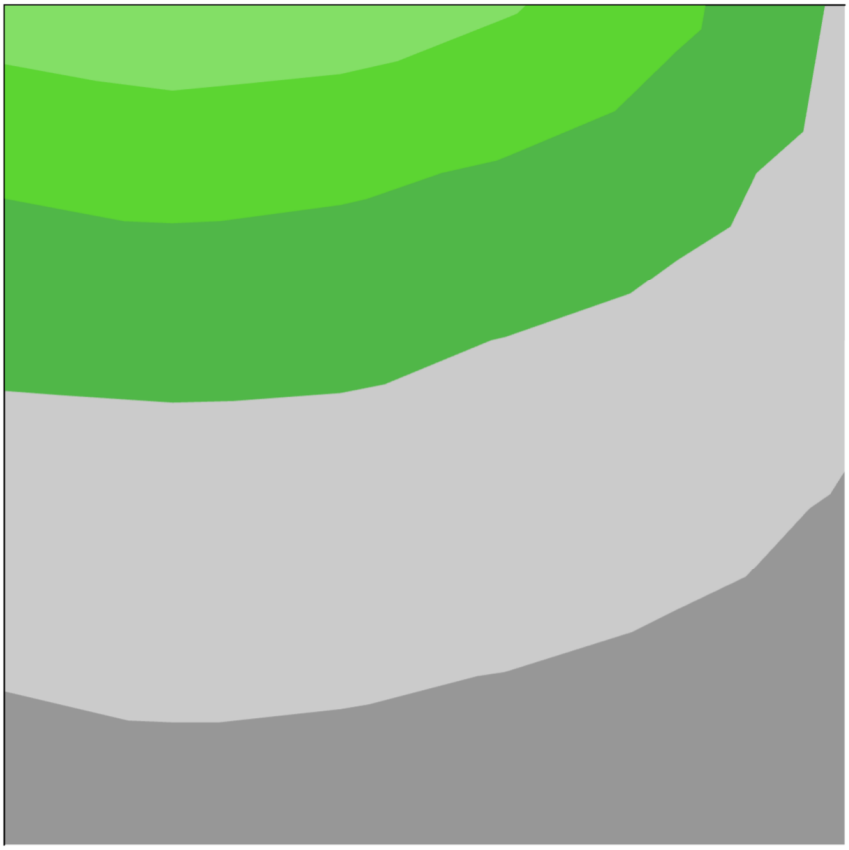
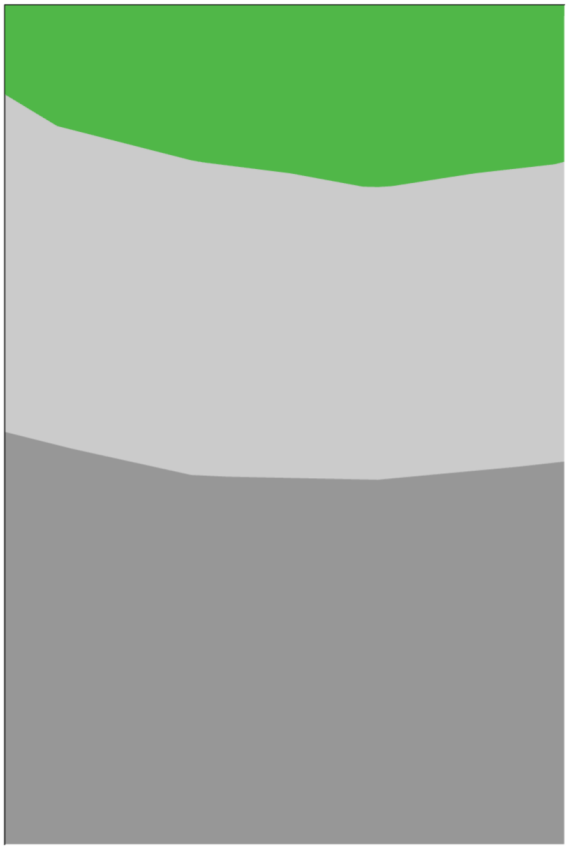
Mittlerer Tageslichtquotient	Dm	: 3.23
Minimaler Tageslichtquotient	Dmin	: 0.62
Maximaler Tageslichtquotient	Dmax	: 9.66



HDU Schlafzimmer
Tageslichtqutient [%]

- 5-6
- 4-5
- 3-4
- 2-3
- 1-2
- 0-1



HDU Badezimmer
Tageslichtquotiet [%]

- 5-6
- 4-5
- 3-4
- 2-3
- 1-2
- 0-1

02 Appendix

Engineering & Construction Report

Bescheinigung

über den

Primärenergiefaktor und Emissionsfaktor

für das Verbundnetz der N-ERGIE Aktiengesellschaft in Nürnberg

Die energetische Bewertung erfolgte nach FW 309 Teile 1 und 7.

Der Gutachter bescheinigt dem Versorgungssystem folgende Kennzahlen:

Primärenergiefaktor (berechnet nach FW 309-1:2014)
f_P nach § 22 Absatz 2, GEG 2020 **0,00**

Primärenergiefaktor (nach Kappung und EE-Bonus, nach GEG zu verwenden)
f_P nach § 22 Absatz 3, GEG 2020 **0,27**

Emissionsfaktor (berechnet nach FW 309-1:2020)
$f_{CO2eq.}$ nach Anlage 9 Nr. 1c, GEG 2020 **0 g/kWh**

Die Berechnung basiert auf Istwerten von 1. Januar 2015 bis 31. Dezember 2017.
Die Bescheinigung gilt von 1. April 2018 bis 31. März 2028.
Die Bescheinigung wurde neu ausgestellt am 27. November 2020 nach FW 309-7:2020, Abschnitt 6.

Aussteller:
Dipl.-Kfm., Dipl.-Ing. (FH) Michael Schwarz
fp-Gutachter-Nr. FW 609-179 (AGFW)

Technische Beschreibung
Absorptionskälteanlage Typ «Biene»

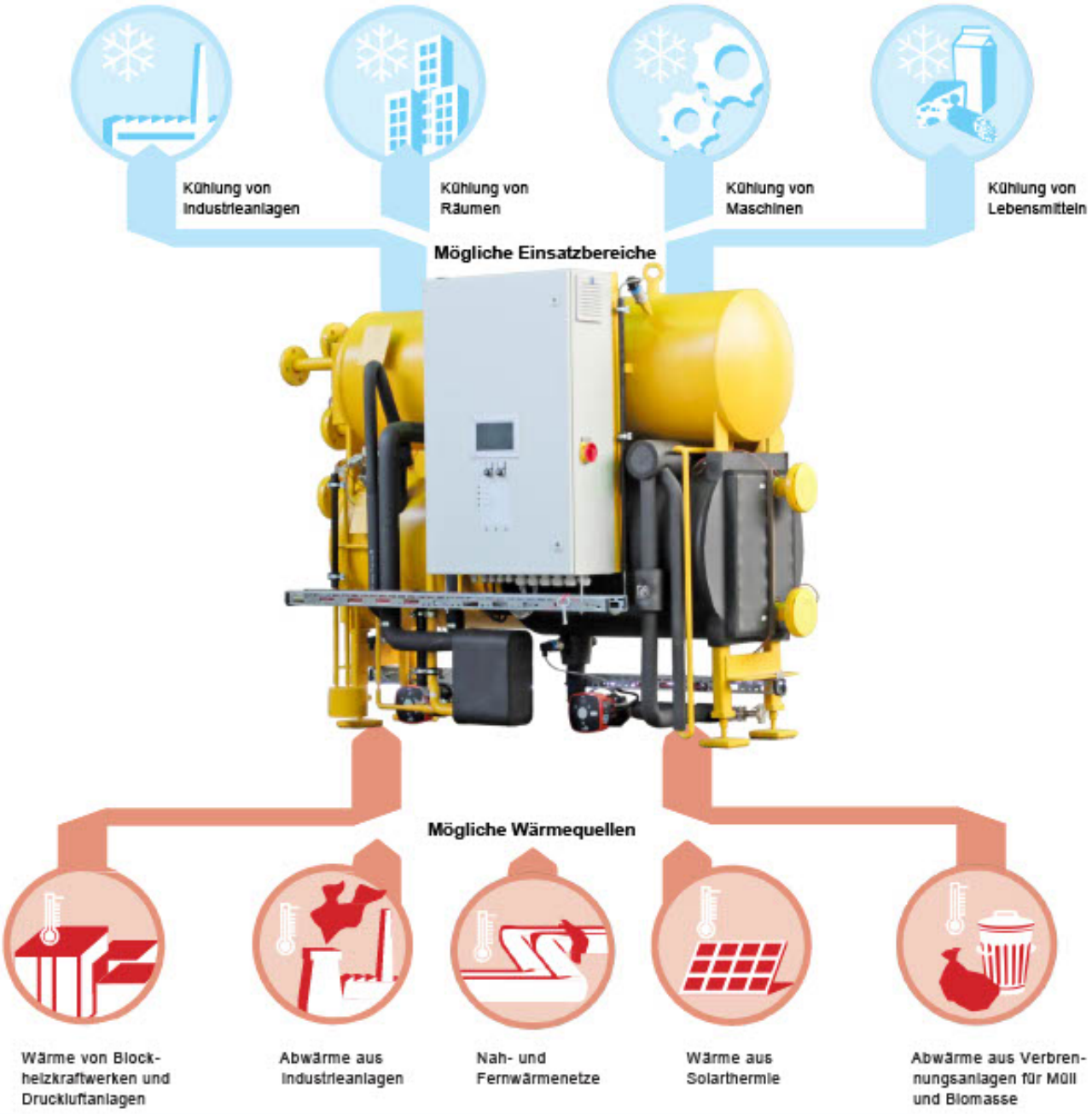
Absorptionskälteanlage Biene

Biene_PH_15100_02_DE_CR_4022.docx

Inhalt

1. Baelz-absorpdynamic® Absorptionskälteanlagen

Optimierte Technologie erweitert die Einsatzmöglichkeiten

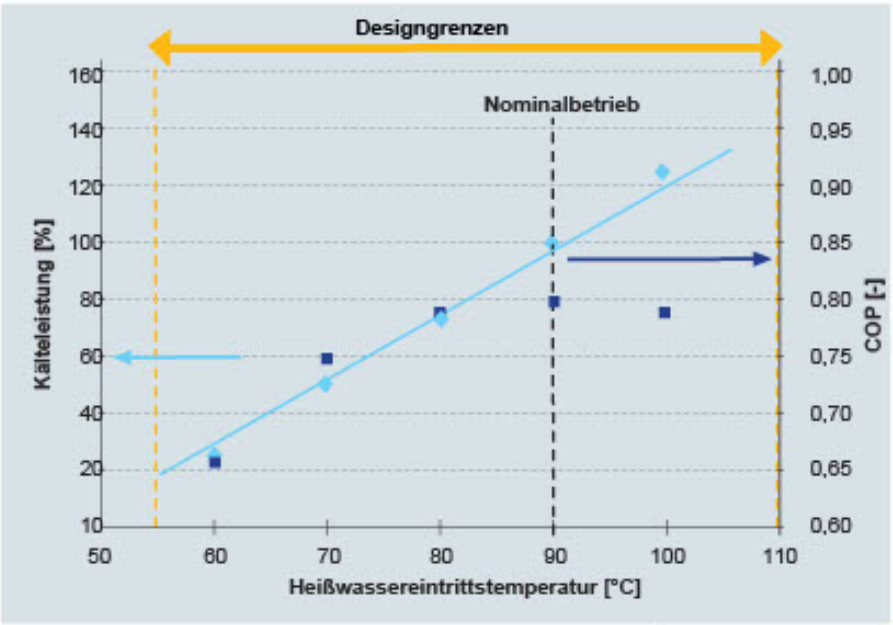


Vorteile auf einen Blick

- ✓ Hohe Spreizungen bei Fernwärmeanwendungen >40 K
- ✓ Thermische Prozesseffizienz, COP bis zu 0,80
- ✓ Niedrige Antriebstemperaturen ab 60°C möglich
- ✓ Prozessdesign für trockene Rückkühlung
- ✓ Wärmerückgewinnung in Heizsystemen bis 45°C
- ✓ Reaktionsschnell, 25% auf 100% Leistung <10 Minuten
- ✓ Türgängigkeit, <0,97m x 1,60m (Biene)
- ✓ Effiziente Systemregelung für min. Betriebs-/Energiekosten

Technische Daten				
Beschreibung	Einheit	Biene	Hummel	Hornisse
Typ		Single-Effect LiBr-H_2O		
Kälteleistung	kW	50	160	500
Wärmeverhältnis	COP	0,80		
T_{min} (Heißwasser/Kaltwasser)	°C	60,0 / 5,0		
T_{max} (Kühlwasser)	°C	40,0		
Länge / Höhe / Breite	m	2,19 / 1,60 / 0,94	2,41 / 2,14 / 1,13	3,74 / 3,24 / 1,83
Leergewicht	kg	1.100	2.100	ca. 8.200

Hohe Variabilität in den Betriebsmöglichkeiten



t_Kaltwasser: 16°C Austritt t_RKW: 30°C Eintritt $\dot{V}$: Nennbedingungen

Die Baelz-Absorptionskälteanlage mit ihrer optimierten Technologie setzt sich durch ihren konstant hohen COP bei Heißwasser-Eintrittstemperaturen von 60 –105°C von konventionellen Absorptionskälteanlagen ab.

COP= Kälteleistung/Wärmeleistung.

Bei einer Heißwassertemperatur von 100°C werden 120% Kälteleistung erreicht. Bei 60°C Heißwasser-temperatur erhält man noch 30% Kälteleistung.

- variabler Heißwasservolumenstrom in Abhängigkeit der Kältelast
- konstante Heißwasserrücklauftemperatur bei gleichzeitig konstanter Kaltwasseraustrittstemperatur
- Rückkühltemperaturen bis 45°C am Austritt der Baelz-Absorptionskälteanlage
- stufenlos angepasste Systemregelung für hohen COP auch bei Teillast und variablen Betriebsbedingungen

2. Funktionsprinzip

Im Gegensatz zu strombetriebenen Kompressionskälteanlagen erzeugt eine Absorptionskälteanlage (AKA) Kälte durch die Nutzung von Wärmeenergie (z. B. Wärme aus Blockheizkraftwerken, Abwärme von Industrieanlagen, Wärme von Solaranlagen, Wärme von Verbrennungsanlagen für Biomasse und Müll oder Wärme aus Nah- und Fernwärmenetzen). Als Arbeitsstoffpaare werden häufig Ammoniak und Wasser oder, wie bei uns, Wasser und Lithiumbromid verwendet.

Funktionsweise einstufiger Wasser-Lithiumbromid Absorptionskälteanlagen

Unsere Absorptionskälteanlage besteht aus zwei Zylindern, in denen sich im oberen Behälter der Desorber + Kondensator, und im unteren Behälter Absorber + Verdampfer befinden. Die Elemente sind durch Rohre miteinander verbunden, um einen geschlossenen Kreislauf zu erhalten. Bei einer Wasser-Lithiumbromid Absorptionskälteanlage wird Wasser als Kältemittel und eine Lithiumbromid-Lösung als Absorptionsmittel verwendet.

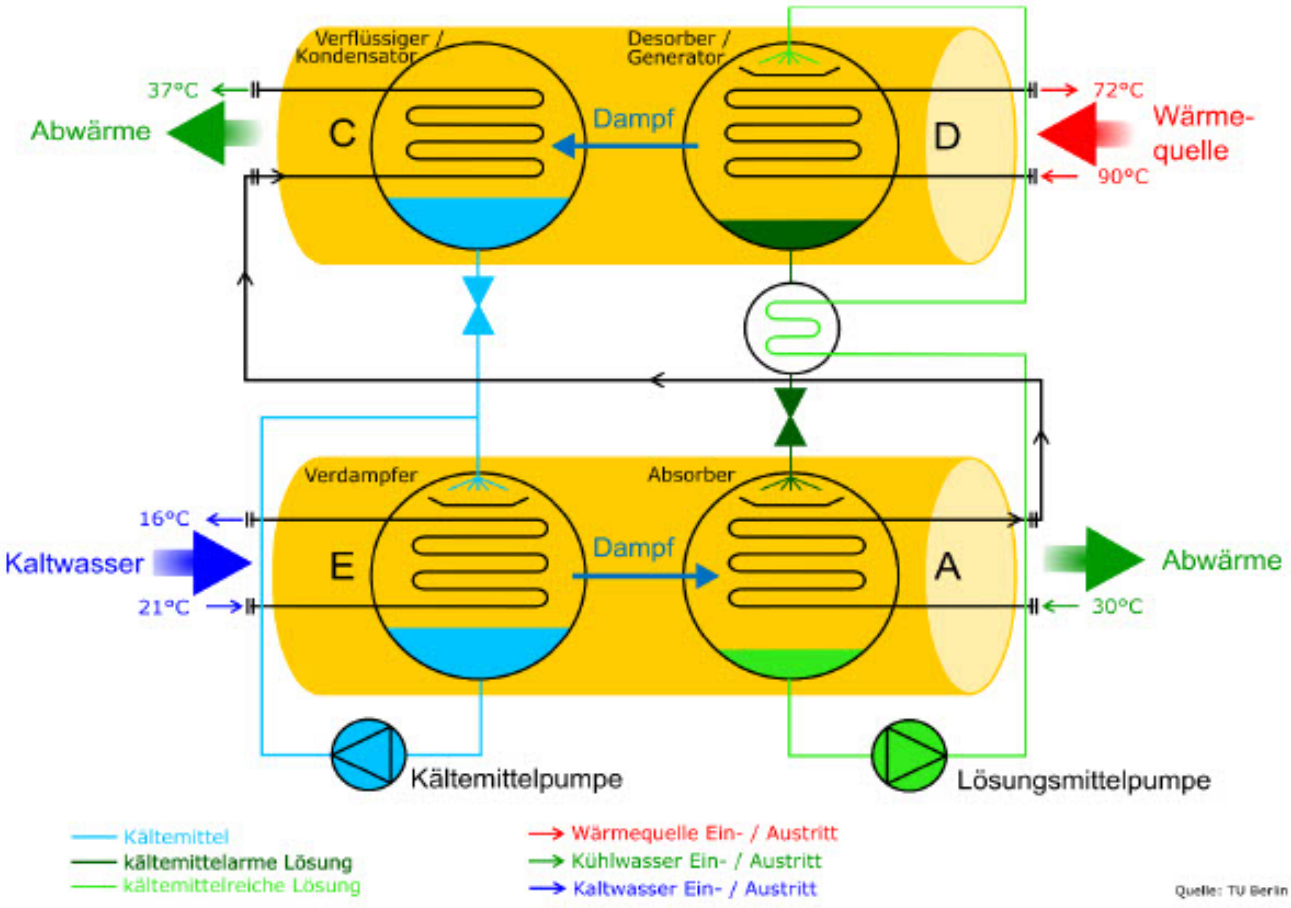


Abb. 1 Absorptionskälteanlagen-Schema

Das Kältemittel Wasser gelangt über ein Berieselungssystem in den Verdampfer. Im sehr tief evakuierten unteren Behälter liegt ein Unterdruck vor. Dies führt dazu, dass das Kältemittel bereits bei niedrigen Temperaturen verdampft. Beim Verdampfungsvorgang wird Wärme aus dem Wärmetauscher entzogen (Kühlung).

Anschließend strömt der Kältemitteldampf in den Absorber. Dort wird das Wasser durch die konzentrierte Lithiumbromid-Lösung aufgenommen (absorbiert).Die bei der Absorption entstehende Wärme wird über den Wärmetauscher an das Kühlwasser abgeführt.

Die Lösung wird nun mit einer Lösungspumpe in den oberen, weniger stark im Vakuum stehenden Vakuumbehälter geleitet. Aufgrund des kleineren spezifischen Volumens des Kältemittels in der „verdünnten Lösung" erfolgt dies unter vernachlässigbar geringem elektrischem Energieaufwand.

Im Desorber/Generator wird die kältemittelreiche Lösung über einen Wärmetauscher berieselt. Durch Zufuhr von Wärme von außen verdampft das Kältemittel (Wasser) und es entsteht eine kältemittelarme Lithiumbromid-Lösung. Wärmequellentemperaturen ab 60 °C können dazu bereits ausreichen. Ist der Kältemitteldampf aus der Lösung ausgetrieben, wird das Lösungsmittel, durch eine Drossel, über ein Berieselungssystem zurück in den Absorber geleitet.

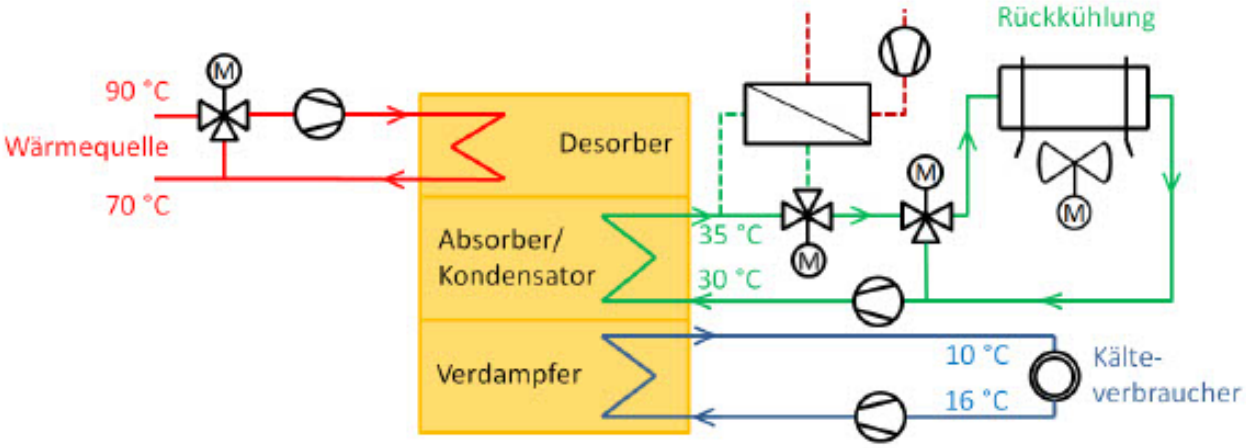
Der Kältemitteldampf wiederum strömt vom Desorber in den Kondensator und wird dort unter Zufuhr von Kühlwasser verflüssigt. Die dabei entstandene Wärme wird ebenfalls über das Kühlwasser abgeführt. Der verflüssigte Dampf gelangt auch hier durch eine Drossel erneut in den Verdampfer und der Kreislauf beginnt von vorne.

Das Stoffgemisch Wasser / wässrige Lithiumbromid-Lösung mit Wasser als Kältemittel hat sich bei Absorptionskälteanlagen in der Klimatisierung und Prozesskühlung durchgesetzt. Dies beruht auf den sehr guten thermodynamischen, kalorischen und physikalischen Eigenschaften, sowie den unkritischen physiologischen Einwirkungen von Lithiumbromid auf den Menschen. Der GWP – Wert (**G**lobal **W**arming **P**otential) ist 0. Dadurch fällt das System auch nicht unter die F-Gase Verordnung!

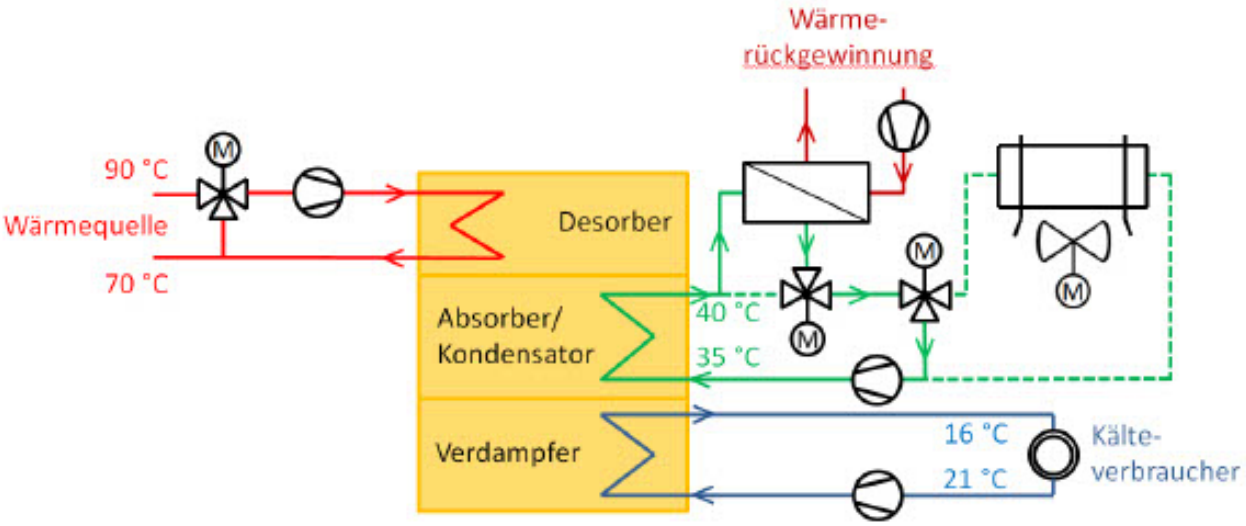
Im Sommer kann mit Hilfe von Absorptionskälteanlagen bis zu einer Temperatur von 5 °C gekühlt werden.

In den Wintermonaten, kann die Anlage mit einer Wärmerückgewinnungseinbindung zum Heizen eingesetzt werden. Hierbei sind Temperaturen von 45 °C möglich. Dabei wird die Abwärme des Absorbers und Kondensators über einen zusätzlichen Wärmetauscher in den Niedertemperatur-Heizkreis eingebunden. Somit ist eine optimale Auslastung über das ganze Jahr hinweg möglich.

AKA im Sommerbetrieb zur Kälteerzeugung

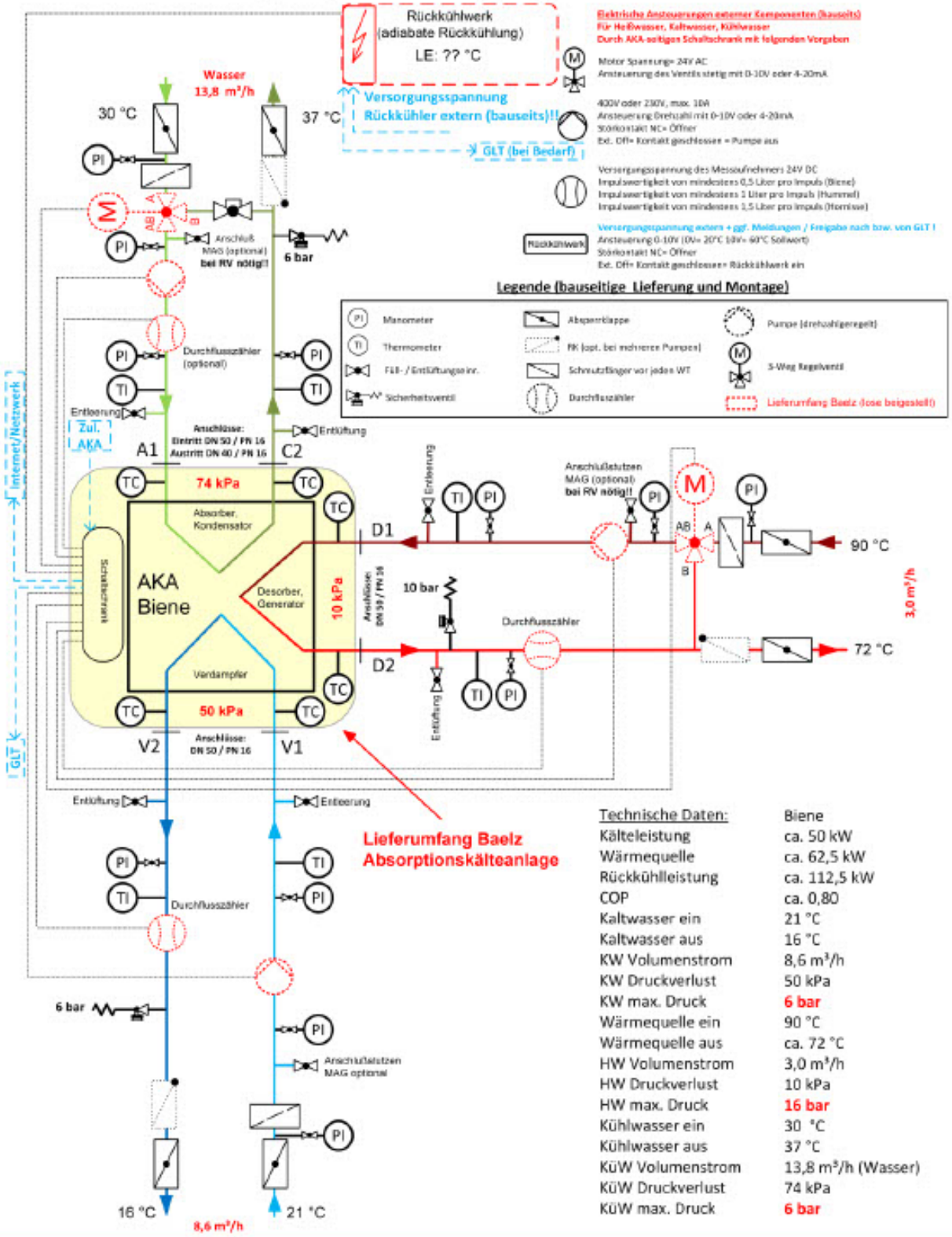


AKA im Winterbetrieb zur Wärmeerzeugung



3. Hydraulisches Schema Absorptionskälteanlage

Für den Betrieb einer Absorptionskälteanlage sind die in der nachstehenden Zeichnung aufgeführten Feldgeräte erforderlich. Die rot markierten Bauteile werden über den Schaltschrank der Anlage angesteuert und geregelt.



Technische Daten:	Biene
Kälteleistung	ca. 50 kW
Wärmequelle	ca. 62,5 kW
Rückkühlleistung	ca. 112,5 kW
COP	ca. 0,80
Kaltwasser ein	21 °C
Kaltwasser aus	16 °C
KW Volumenstrom	8,6 m³/h
KW Druckverlust	50 kPa
KW max. Druck	6 bar
Wärmequelle ein	90 °C
Wärmequelle aus	ca. 72 °C
HW Volumenstrom	3,0 m³/h
HW Druckverlust	10 kPa
HW max. Druck	16 bar
Kühlwasser ein	30 °C
Kühlwasser aus	37 °C
KüW Volumenstrom	13,8 m³/h (Wasser)
KüW Druckverlust	74 kPa
KüW max. Druck	6 bar

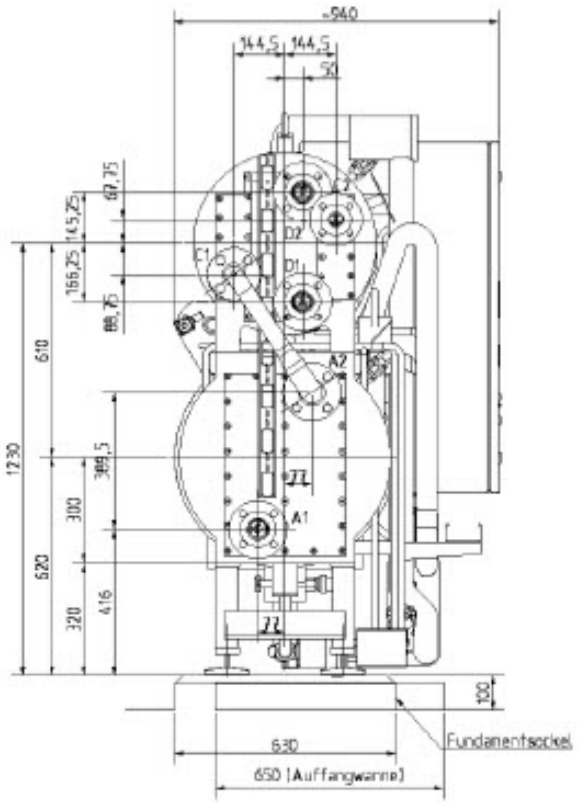
4. Nennbetriebsdaten und technische Daten

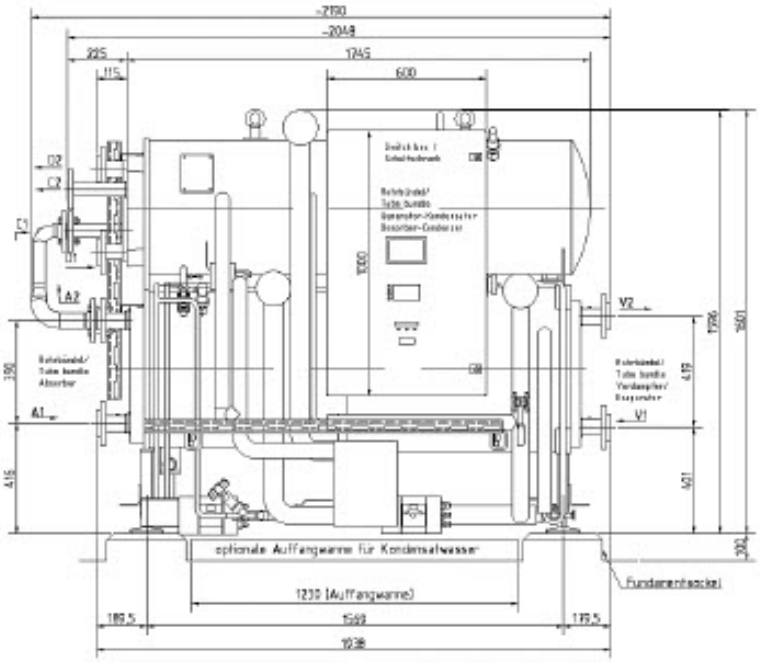
Nennbetriebsdaten	Einheit	Wert
Kälteleistung	kW	50
Heizleistung	kW	62,5
Wärmeabfuhr	kW	112,5
COP		0,8
Kaltwasser		
Eintrittstemperatur	°C	21
Austrittstemperatur	°C	16
Volumenstrom	m^3/h	8,6
Druckverlust	kPa	50
max. Druck	bar	6
Anschlüsse V1 / V2	DN / PN	50 / 16
Wärmequelle		
Eintrittstemperatur	°C	90
Austrittstemperatur	°C	72
Volumenstrom	m^3/h	3,0
Druckverlust	kPa	10
max. Druck	bar	16
Anschlüsse D1 / D2	DN / PN	50 / 16
Kühlwasser		
Eintrittstemperatur	°C	30
Austrittstemperatur	°C	37
Volumenstrom	m^3/h	13,8
Druckverlust	kPa	74
max. Druck	bar	6
Anschluss A1 Eintritt Anschluss C2 Austritt	DN / PN	50 / 16 40 / 16

Technische Daten	Einheit	Wert
Länge	mm	2.190
Breite	mm	940
Höhe	mm	1.601
Leergewicht	kg	1.100
Betriebsgewicht	kg	1.360
Störgewicht	kg	1.944
Füllung ca.		
LiBr - Lösung	l	ca. 50
Wasser	l	ca. 25
Elektrische Anschlüsse		
Stromart	V/Ph/Hz	400/3/50
Leistungsaufnahme *	W	max. 400
* (ohne externe Feldgeräte)		

Technische Änderungen vorbehalten

Maßzeichnung

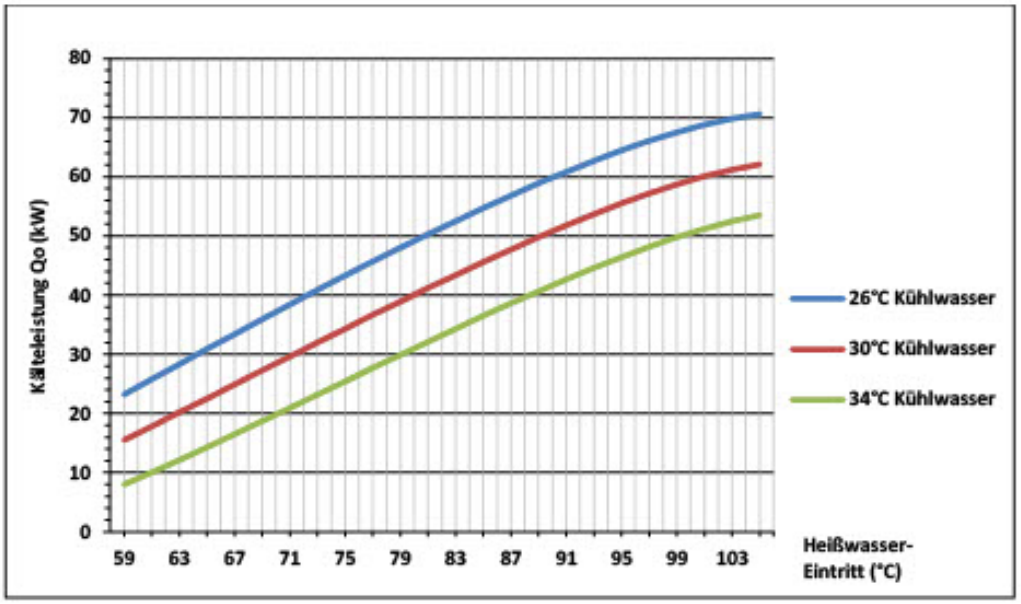




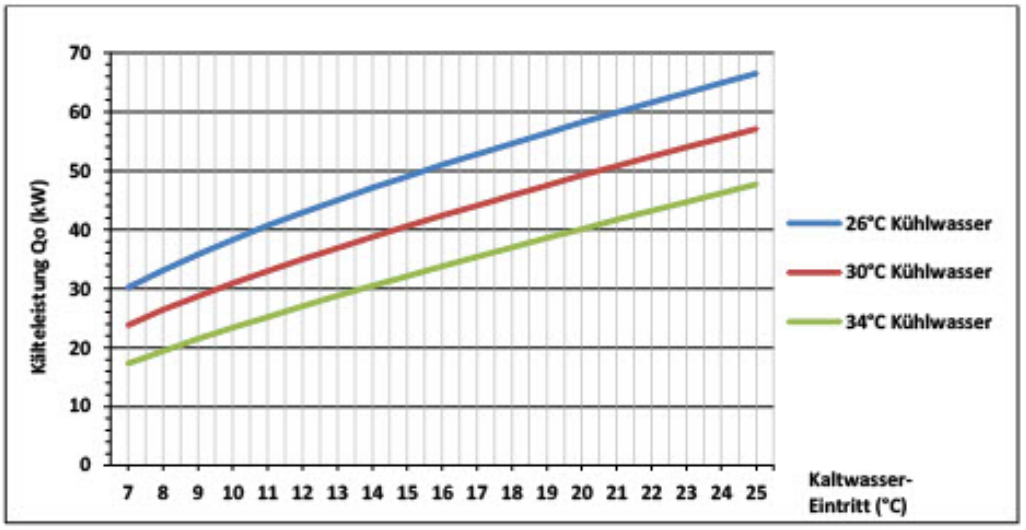
5. Kennlinienfelder (thermisch)

Rahmenbedingungen Referenzbetriebspunkt

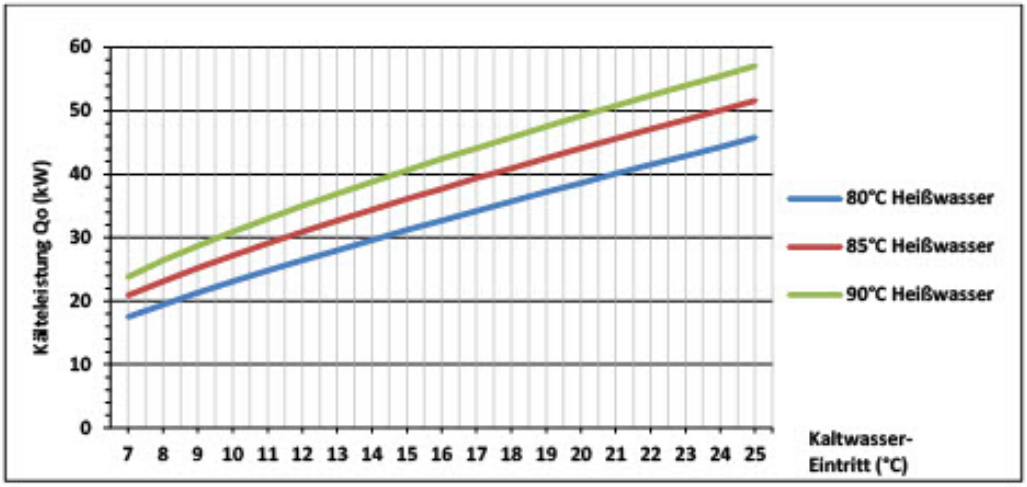
a) Kühlwassereintritt: 26°C / 30°C / 34°C
Volumenstrom: Nenndaten
Kaltwassereintritt: 21 °C



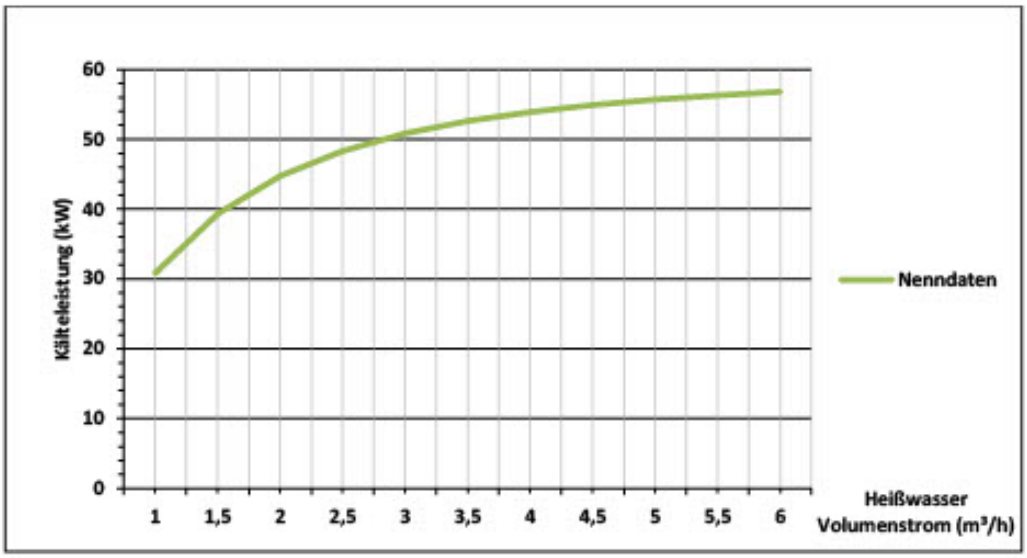
b) Kühlwassereintritt: 26°C / 30°C / 34°C
Volumenstrom: Nenndaten
Heißwassereintritt: 90°C



c) Heißwassereintritt: 80°C / 85°C / 90°C
Volumenstrom: Nenndaten
Kühlwassereintritt: 30 °C

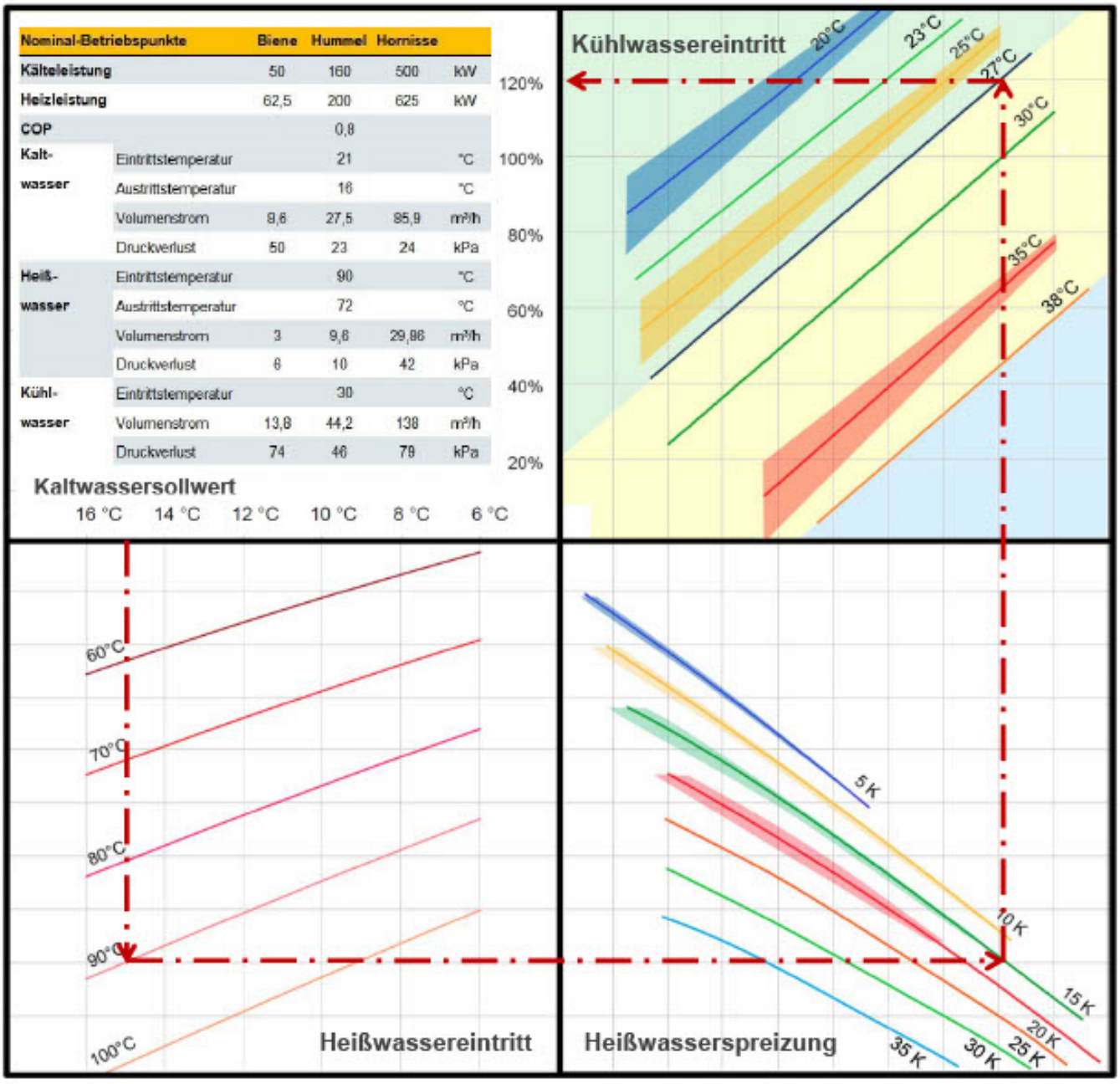


d) Kühlwasser- / Kaltwassereintritt: 30°C / 21°C
Volumenstrom Kaltwasser: Nenndaten
Volumenstrom Kühlwasser: Nenndaten
Heißwassereintritt: 90°C



6. Nomogramm (Unterstützung zur Kälteleistungsrichtwertermittlung)

Nominal-Betriebspunkte		Biene	Hummel	Hornisse	
Kälteleistung		50	160	500	kW
Heizleistung		62,5	200	625	kW
COP			0,8		
Kalt-wasser	Eintrittstemperatur		21		°C
	Austrittstemperatur		16		°C
	Volumenstrom	8,6	27,5	85,9	m³/h
	Druckverlust	50	23	24	kPa
Heiß-wasser	Eintrittstemperatur		90		°C
	Austrittstemperatur		72		°C
	Volumenstrom	3	9,6	29,86	m³/h
	Druckverlust	6	10	42	kPa
Kühl-wasser	Eintrittstemperatur		30		°C
	Volumenstrom	13,8	44,2	138	m³/h
	Druckverlust	74	46	79	kPa



Aus dem Nomogramm lässt sich über die Kaltwassertemperatur, Eintrittstemperatur des Heißwassers, die Heißwasserspreizung und Eintrittstemperatur des Kühlwassers (ohne Glykol) die ca. Kälteleistung auslesen. Man erreicht z. B. bei einer Kaltwassertemperatur von 15 °C und mit Heißwasserein- / Austrittstemperaturen von 90 / 75 °C, sowie einer Kühlwassertemperatur von 27 °C eine Kälteleistung von ca. 60 kW (Biene) bzw. 192 kW (Hummel), siehe den roten, gestrichelten Pfeil im Diagramm.

Bitte beachten: Das Nomogramm ist mit Nennvolumenströmen definiert! Die Ergebnisse können bei abweichenden Bedingungen deutlich von den berechneten Werten des Auslegungsprogramms abweichen. Für genaue Berechnungen wenden Sie sich bitte an eine unserer Niederlassungen.

03 Appendix

Affordability & Viability Report

37.3 CONCEPTS APPENDIX

CUSTOMARY LOCAL RENTS

Determination of the local comparative rent Year of construction: 1941

Living space: 46.26 sqm rounded down to 46 sqm

Monthly basic net rent in Euro per square metre: 8.90

Sum of surcharges and deductions according to year of construction and furnishings: -4%.

Calculation of the surcharge or discount in euros per m²

Net cold rent in € per m²	*Percent / 100	Euro per m ²
8,90€	*(-4) / 100	= -0,36

Average rent per m²

Net cold rent in € per m²	8,90
Surcharge/deduction in € per m²	-0,36
= Total amount € per m² (middle value)	= 8,54

Range (+/- 22%)

Lower value: - 22% (Total amount € per m² * 0,78)	Middle value	Upper Value: + 22% (Total amount € per m² * 1,22)
6,66 € / m²	8,54 € / m²	10,42 € / m²
306,36 €	392,84 €	10,42 €

CUSTOMARY LOCAL RENTS

Determination of the local comparative rent Year of construction: 1941

Living space: : 60.9sqm rounded down to 61 sqm

Monthly basic net rent in Euro per square metre: 8.30

Sum of surcharges and deductions according to year of construction and furnishings: -4%.

Calculation of the surcharge or discount in euros per m²

Net cold rent in € per m²	*Percent / 100	Euro per m ²
8,30€	*(-4) / 100	= -0,33

Average rent per m²

Net cold rent in € per m²	8,30
Surcharge/deduction in € per m²	-0,33
= Total amount € per m² (middle value)	= 7,97

Range (+/- 22%)

Lower value: - 22% (Total amount € per m² * 0,78)	Middle value	Upper Value: + 22% (Total amount € per m² * 1,22)
6, 22 € / m²	7,97 € /m²	9,73 € /m²
379,42 €	486,17 €	593,53 €

Operational Costs

Comparison: Calculation of water charges for 2-person-household

Daily water consumption per person	129 – 49 = 80 L
Rental area	61 sqm
Waste water fee	80L*2 Persons*365 days = 58.400L = 59 Cubic metres 59 Cubis metres * 1,67 = 99 €
Rainwater amounts	61 sqm * 0,43 = 26 €
Total for 3-person household	99€ + 26€ = 125€

Daily water consumption per person	129 L
Fortified area	61 sqm
Waste water charge	129L*2 Persons*365 days = 94.170L = 94 Cubic metres 94 Cubis metres * 1,67 = 157 €
Rainwater fee	61 sqm * 0,43 = 26€
Total for 3-person household	157€ + 26€ = 183€

	Water consumption	Water fees
Average value	129L	183€
With levelup	80L	125€
Savings	49L	58€

SHARING CONCEPT

1. Cost Accounting

Producer	Renault	VW	Mercedes
Description	Zoe	ID3	EQA
Equipment line	LIFE	Pure Performance	Basismodell
Leasing / Purchase	Leasing	Leasing	Leasing
Term (a)	2	2	2

List price	25.201,68 €	31.495,00 €	39.950,00 €
Advance payment	6.000,00 €	6.000,00 €	6.000,00 €
state subsidy	6.000,00 €	6.000,00 €	6.000,00 €
Delivery	32,49 €	41,25 €	22,02 €
Leasing monthly rate	203,59 €	182,41 €	505,84 €
Insurance	79,93 €	209,23 €	94,59 €
Full Service Package	17,84 €	17,84 €	43,83 €
Manufacturer's guarantee	6,67 €		
Monthly rate	**340,52 €**	**450,73 €**	**666,28 €**

Mileage per year (km)	20.000	20.000	20.000
Battery	41 kWh	45 kWh	66,5 kWh
Performance	79 kW	110 kW	140 kW
Consumption WLTP (kWh / 100 km)	17,2	13,8	17,7
Real consumption ADAC (kWh / 100 km	20,3	*19,8*	*21*
Electricity price small business (per kW	0,21 €	0,21 €	0,21 €
Consumption per month (kWh)	338,3	330,0	350,0
Electricity costs / month	**71,73 €**	**69,96 €**	**74,20 €**

Pitch rent / month	80,00 €	80,00 €	80,00 €
Wallbox E.ON Drive eBox professional	1.299,00 €	1.299,00 €	1.299,00 €
Wallbox Installation	1.000,00 €	1.000,00 €	1.000,00 €
KFW subsidy	900,00 €	900,00 €	900,00 €
Infrastructure / month	**138,29 €**	**138,29 €**	**138,29 €**
Child seat	299,00 €	299,00 €	299,00 €
Zusatzequipment / Monat	**12,46 €**	**12,46 €**	**12,46 €**

Personnel expenses / month (h)	3	3	3
Hourly rate	32,50 €	32,50 €	32,50 €
Staff costs / month	**97,50 €**	**97,50 €**	**97,50 €**

Total cost per month	**660,50 €**	**768,94 €**	**988,73 €**
Total cost per kilometre	**0,40 €**	**0,46 €**	**0,59 €**
TC at end of term	**15.851,92 €**	**18.454,44 €**	**23.729,52 €**

Fahrzeug	Fahrrad	E-Bike	E-Lastenrad	E-Lastendreirad
Hersteller	Falter	Fischer	Fischer	Prophete
Bezeichnung	C4.0	Cita 6.0i	Leo 1.0	Cargo 3R
Leasing / Kauf	Kauf	Kauf	Kauf	Kauf

list price	679,00 €	2.349,00 €	3.549,00 €	2.599,95 €
Useful life (a)	5	5	5	5
Mileage (km)	10000	10000	10000	10000
Amortisation / month	11,32 €	39,15 €	59,15 €	43,33 €

Battery (kWh)	-	0,504	0,522	0,324
Expected range (km)	-	60,4	35,2	30
Consumption (kWh / 100 km)	-	0,83	1,48	1,08
Consumption per month (kWh)	-	6,95	12,36	9,00
Electricity costs / month	- €	1,47 €	2,62 €	1,91 €

Insurance / month	7,08 €	7,74 €	9,89 €	7,99 €

Bicycle parking space (if in garage)	- €	10,00 €	20,00 €	20,00 €
Infrastructure / month	- €	10,00 €	20,00 €	20,00 €

Bike lock ABUS Granit X-Plus 540	104,95 €	104,95 €	104,95 €	104,95 €
Front bicycle basket	44,99 €	44,99 €		44,99 €
Rear bicycle bags	84,99 €	84,99 €		
Mobile phone holder/pocket	29,95 €	29,95 €	29,95 €	29,95 €
Helmet	60,00 €	60,00 €	60,00 €	60,00 €
Child seat	105,99 €	105,99 €		
Child trailer	764,99 €	764,99 €		
Transport trailer	467,99 €	467,99 €		
Replacement battery	-	499,00 €	479,00 €	469,95 €
Additional equipment / month	12,32 €	20,64 €	11,23 €	11,83 €

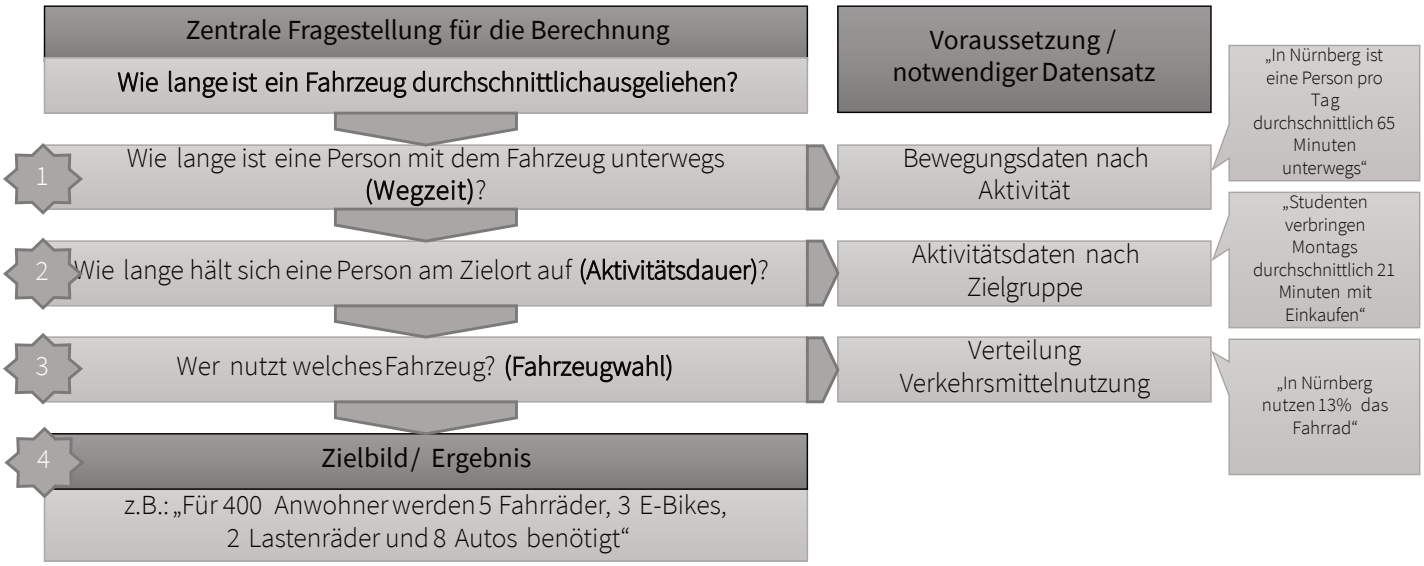
Personnel expenses / month (h)	1	1,5	1,5	1,5
Hourly rate	32,50 €	32,50 €	32,50 €	32,50 €
Staff costs / month	32,50 €	48,75 €	48,75 €	48,75 €

Total cost per month	**63,22 €**	**127,75 €**	**151,64 €**	**133,81 €**
Total cost per kilometre	**0,08 €**	**0,15 €**	**0,18 €**	**0,16 €**
TC at end of term	**3.792,92 €**	**7.664,97 €**	**9.098,49 €**	**8.028,67 €**

SHARING CONCEPT

2. Calculation of the vehicle requirements

2. Calculation of the vehicle requirements - Method



2. Step 1

1 Wie lange ist eine Person mit dem Fahrzeug unterwegs **(Wegzeit)**?

Bewegungsdaten nach Aktivität

	Total	Monday till Friday	Saturday	Sunday and public holiday
Work	*20%*	*25%*	*7%*	*7%*
Business / official	*2%*	*3%*	*0%*	*0%*
Training	*8%*	*11%*	*2%*	*1%*
Purchase	23%	22%	38%	7%
Service use	7%	8%	3%	3%
Accompaniment	6%	6%	5%	4%
Leisure	34%	25%	45%	78%

Fact: In Nuremberg, the average person is on the road for 65 minutes per day&

Assumption: The commuting time is distributed proportionally to the shares of the commuting purposes (e.g. 20% work means 20% * 65 minutes commuting time).&

Adjustment: Since the sharing concept is not suitable for time-intensive activities, the trip purposes work, business and education are not considered any further from this point on. This results in a new distribution key. For this reason, the daily commuting time is also adjusted proportionally: 65 min - (work/office/education) * 65 min&

&

Travel time	Total	Monday till Friday	Saturday	Sunday and public holiday
Dauer (min)	0:45	0:39	0:59	0:59

Target group	Total	Monday till Friday	Saturday	Sunday and public holiday
Purchase	33%	36%	42%	8%
Service use	10%	13%	3%	3%
Accompaniment	9%	10%	5%	4%
Leisure	49%	41%	49%	85%

Average travel times	Total	Monday till Friday	Saturday	Sunday and public holiday
Purchase	0:14	0:14	0:24	0:04
Service use	0:04	0:05	0:01	0:01
Accompaniment	0:03	0:03	0:03	0:02
Leisure	0:22	0:16	0:29	0:50

(Alle Angaben in h:mm)

2. Step 2.1

2 Wie lange hält sich eine Person am Zielort auf **(Aktivitätsdauer)**?

Aktivitätsdaten nach Zielgruppe

Full-time employed	Total	Mo - Fr	Mo	Tue	Wed	Thur	Fr	Sa	Sunday
On the road	*1:28*	*1:30*	*1:28*	*1:27*	*1:27*	*1:32*	*1:38*	*1:28*	*1:21*
Work, Official	*4:38*	*6:12*	*6:06*	*6:33*	*6:36*	*6:18*	*5:29*	*0:59*	*0:30*
School, Training	*0:01*	*0:02*	*0:02*	*0:02*	*0:04*	*0:01*	*0:01*	*0:00*	*0:00*
Shopping	0:31	0:25	0:25	0:23	0:25	0:23	0:31	1:04	0:26
Leisure	0:51	0:34	0:29	0:31	0:35	0:34	0:45	1:27	1:40
Other	0:15	0:16	0:15	0:16	0:17	0:14	0:18	0:19	0:12
Total	**1:38**	**1:16**	**1:09**	**1:10**	**1:17**	**1:11**	**1:34**	**2:50**	**2:18**

(Alle Angaben in h:mm)

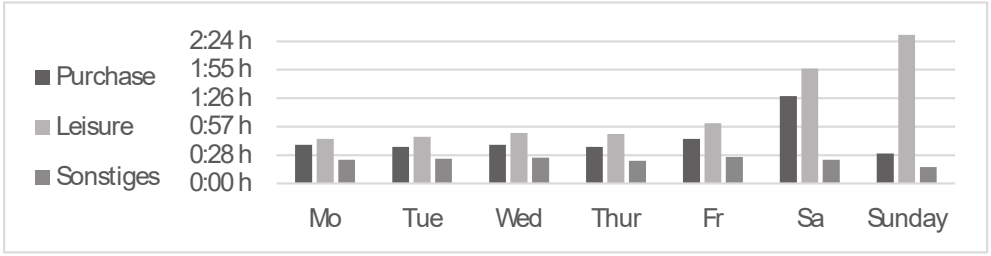
Average travel times	Total	Monday till Friday	Saturday	Sunday and public holiday
Purchase	0:14	0:14	0:24	0:04
Service use	0:04	0:05	0:01	0:01
Accompaniment	0:03	0:03	0:03	0:02
Leisure	0:22	0:16	0:29	0:50

= „Sonstiges“

(Alle Angaben in h:mm)

Aus den Zeitdauern für Wegstrecken bestimmter Aktivitäten und den Dauern der Aktivitäten selbst lassen sich mögliche personen- und aktivitätsspezifische Nachfragekurven nach Sharing-Fahrzeugen über den Wochenverlauf hinweg errechnen. Um die Datenquellen konsolidieren zu können, wird die Annahme getroffen, dass die Kategorien "Inanspruchnahme von Dienstleistungen" sowie "Begleitung" der Kategorie "Sonstiges" entsprechen.

Full-time employed	Total	Mo - Fr	Mo	Tue	Wed	Thur	Fr	Sa	Sunday
Purchase	0:45	0:39	0:39	0:37	0:39	0:37	0:45	1:28	0:30
Leisure	1:14	0:51	0:45	0:47	0:51	0:50	1:01	1:56	2:30
Sonstiges	0:23	0:25	0:24	0:25	0:26	0:23	0:27	0:24	0:16
Total	**2:23**	**1:55**	**1:48**	**1:49**	**1:56**	**1:50**	**2:13**	**3:49**	**3:17**



- Analoges Vorgehen für die Zielgruppen „Schüler“ und „Rentner“
- Ergebnis: „Ein Erwerbstätiger ist Montags insgesamt 39 Minuten unterwegs um einzukaufen.“

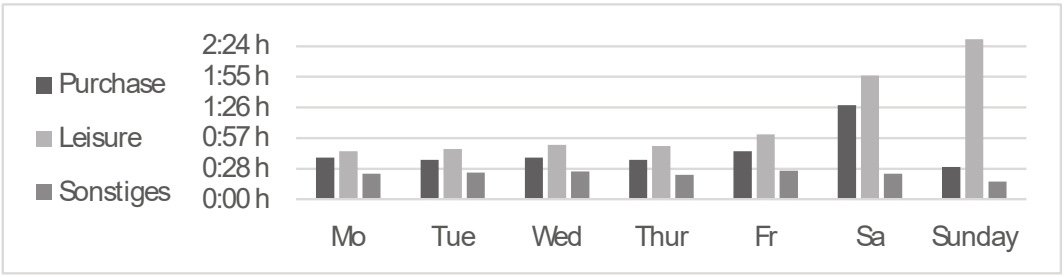
2. Step 2.2

2 Wie lange hält sich eine Person am Zielort auf **(Aktivitätsdauer)**?

Aktivitätsdaten nach Zielgruppe

Fact: Every Nuremberg resident leaves the house 1.2 times a day, but changes residence 2.9 times.
--> So connects several activities with each other
Assumption: only 1 vehicle from the sharing pool needed per day.
Assumption: the person uses the vehicle for all activities (shopping, leisure and other) in succession. The sum of these activities results in the rental period.

Fact: around 46% walk or use public transport.
Assumption: A vehicle from the sharing pool is only needed every 2nd day, as no vehicle is used for half of the activities.
In other words, activity durations over the course of the week reflect vehicle needs for 2 people.



Problematik: um eine gemeinsame zielgruppenübergreifende Lastkurve bzw. Nachfragekurve für die Leihfahrzeuge zu erstellen, muss definiert werden wie sich die Bewohnerstruktur zusammensetzt.
Fakt: Im Bestandsobjekt leben ausschließlich Erwerbstätige mit ihren Kindern (Schüler) und Rentner.
Annahme: Erwerbstätige und Rentner fließen je zu 40 % und Kinder zu 20 % in die Lastkurven ein."

Unter 10 Bewohnern befinden sich 4 Erwerbstätige, 4 Rentner und 2 Kinder. Deren spezifische Lastkurven ergeben addiert den gemeinsamen Fahrzeugbedarf im Wochenverlauf.

Somit steht fest wer, wie lange und für was ein Fahrzeug benötigt, aber nicht welches.
→ Schritt 3

2. Step 3.1

3 Wer nutzt welches Fahrzeug? (Fahrzeugwahl) → Verteilung Verkehrsmittelnutzung

	Total	Monday till Friday	Saturday	Sunday and public holiday
on foot	*23%*	*22%*	*25%*	*26%*
public transport	*23%*	*23%*	*21%*	*20%*
Bicycle	13%	14%	11%	12%
Motorised two-wheeler	1%	1%	0%	0%
Car as driver	32%	32%	31%	26%
Car as passenger	9%	8%	12%	16%

Assumption: Since the sharing concept does not concern pedestrians or the use of public transport,
these criteria are not considered further from this point on. The result is a new distribution key.

Adjustment: The new distribution key reflects the demand for the respective sharing vehicles

Target group	Total	Monday till Friday	Saturday	Sunday and public holiday
Bicycle	24%	25%	20%	22%
Motorised two-wheeler	2%	2%	0%	0%
Car as driver	58%	58%	57%	48%
Passenger car	16%	15%	22%	30%

Assumption: According to "Mobility in Nuremberg", there is an alternative to the car in 56% of all cases, which is only not perceived due to subjective reasons. Of these, the bicycle could be used in 32% of cases. Since the sharin concept provides for an extensive range of bicycles (including cargo bikes and additional equipment), the 56% * 32% in the distribution is transferred to bicycle use. In addition, the drivers of motorised two-wheelers are to be persuaded to switch to the sharing pool through e-bikes. These are therefore also transferred. This results in a final distribution key for the demand for sharing vehicles.

Demand target group	Total	Monday till Friday	Saturday	Sunday and public holiday
Bicycle	39%	40%	35%	36%
Car (driver or passenger)	61%	60%	65%	64%

Die vorhanden Daten lassen nur auf die voraussichtliche Nutzungsverteilung von „Fahrrad“ und „PKW“ schließen, aber beispielsweise nicht, ob ein Lastenrad oder ein normales Fahrrad benötigt wird. → Schritt 3.2

2. Step 3.2

3 Wer nutzt welches Fahrzeug? **(Fahrzeugwahl)** → Verteilung Verkehrsmittelnutzung

	Renault Zoe	VW ID3	Mercedes EQA	Falter C 4.0	Fischer Cita6.0i	Fischer Leo 1.0	Prophete Cargo 3R
ExpectedUse	High	High	Low	High	High	Medium	Medium

Annahme: Die Nachfrage nach den verschiedenen Fahrzeugen entspricht der Bedarfsermittlung, welche im Rahmen der Zielgruppenanalyse und Fahrzeugauswahl durchgeführt wurde.

Vehicle	Demand vehicle	Demand vehicle type	Total share
Bike	40%	39%	16%
E-bike	30%	39%	12%
Cargo bike	15%	39%	6%
Cargo tricycle	15%	39%	6%
Renault	45%	61%	28%
VW	45%	61%	28%
Mercedes	10%	61%	6%

Für die zuvor errechnete Nachfrageverteilung von KFZ und Rädern wird somit weiter zwischen den einzelnen Fahrzeugen differenziert. Multipliziert man die Nachfrage einer Fahrzeugart mit dem erwarteten Bedarf eines Fahrzeugs, ergibt sich ein Verteilungsschlüssel, welcher den voraussichtlichen Bedarf des Fahrzeugs wiederspiegelt. Z.B.: „16% aller ausgeliehenen Fahrzeuge sind Fahrräder“

2. Step 4.1

4 Zielbild / Ergebnis

&& Problematik: um eine gemeinsame zielgruppenübergreifende Lastkurve bzw. Nachfragekurve für die Leihfahrzeuge zu erstellen, muss definiert werden wie sich die Bewohnerstruktur zusammensetzt.
&& Fakt: Im Bestandsobjekt leben ausschließlich Erwerbstätige mit ihren Kindern (Schüler) und Rentner.
&& Annahme: Erwerbstätige und Rentner fließen je zu 40 % und Kinder zu 20 % in die Lastkurven ein."

Assumptions Resident structure

Residents	employed persos	students/ pupils	pensioners
400	40%	20%	40%

Full-time employed	Total	Mo - Fr	Mo	Tue	Wed	Thur	Fr	Sa	Sunday
Purchase									
Leisure									
Sonstiges									
Total									

Pupils	Total	Mo - Fr	Mo	Tue	Wed	Thur	Fr	Sa	Sunday
Purchase	0:45	0:47	0:51	0:50	1:08	1:58	2:30	0:50	0:15
Leisure	0:28	0:24	0:24	0:26	0:28	0:26	0:24		
Sonstiges									
Total									

Pensioners	Total	Mo - Fr	Mo	Tue	Wed	Thur	Fr	Sa	Sunday
Purchase	1:56	1:10	1:59	1:17	2:13	1:10	3:48	0:35	1:21	0:25	1:20	1:21	0:29
Leisure	**1:58**	1:14	**2:00**	1:01	**2:08**	0:56	**2:10**	1:05	**2:18**	1:04	**3:39**	1:02	**3:07**	1:01	1:27	2:02
Sonstiges	0:23	0:25	0:24	0:25	0:25	0:25	0:26	0:19	0:20
Total	**2:48**	**2:44**	**2:30**	**2:46**	**2:46**	**2:48**	**2:47**	**3:08**	**2:52**

Superimposed demand curve (h)

Mo	Tue	Wed	Thur	Fr	Sa	Sunday
297:23	314:11	324:27	321:39	345:55	491:45	433:32

Vehicle	Demand vehicle	Demand vehicle type	Total share	Mo	Tue	Wed	Thur	Fr	Sa	Sunday
Bike	40%	39%	16%	46:10	48:46	50:22	49:56	53:42	76:20	67:18
E-bike	30%	39%	12%	34:37	36:35	37:46	37:27	40:16	57:15	50:28
Cargo bike	15%	39%	6%	17:18	18:17	18:53	18:43	20:08	28:37	25:14
Cargo tricycle	15%	39%	6%	17:18	18:17	18:53	18:43	20:08	28:37	25:14
Renault	45%	61%	28%	81:52	86:30	89:20	88:33	95:14	135:23	119:22
VW	45%	61%	28%	81:52	86:30	89:20	88:33	95:14	135:23	119:22
Mercedes	10%	61%	6%	18:11	19:13	19:51	19:40	21:09	30:05	26:31

(in h)

Expected vehicle utilisation per day (vehicle is on the road)

6:00 hours

Vehicle demand by type and day of the week (number)

absolute

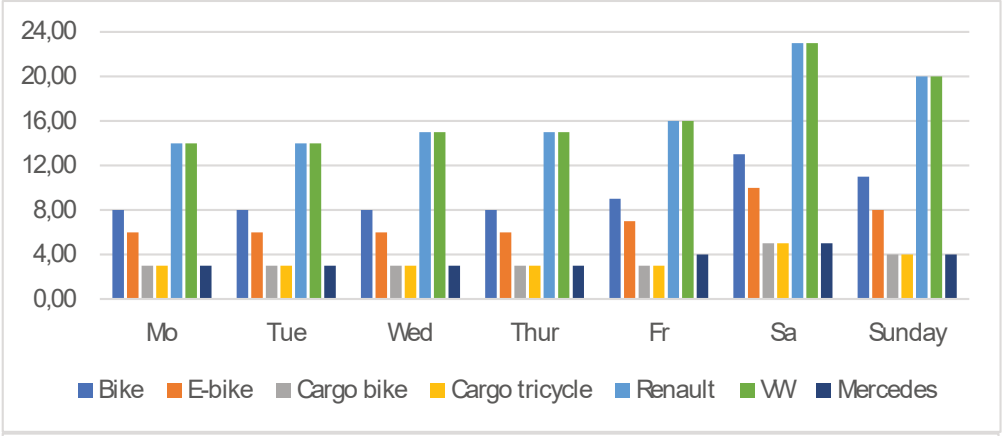
Vehicle	Mo	Tue	Wed	Thur	Fr	Sa	Sunday
Bike	7,69	8,13	8,40	8,32	8,95	12,72	11,22
E-bike	5,77	6,10	6,30	6,24	6,71	9,54	8,41
Cargo bike	2,89	3,05	3,15	3,12	3,36	4,77	4,21
Cargo tricycle	2,89	3,05	3,15	3,12	3,36	4,77	4,21
Renault	13,65	14,42	14,89	14,76	15,87	22,57	19,89
VW	13,65	14,42	14,89	14,76	15,87	22,57	19,89
Mercedes	3,03	3,20	3,31	3,28	3,53	5,01	4,42

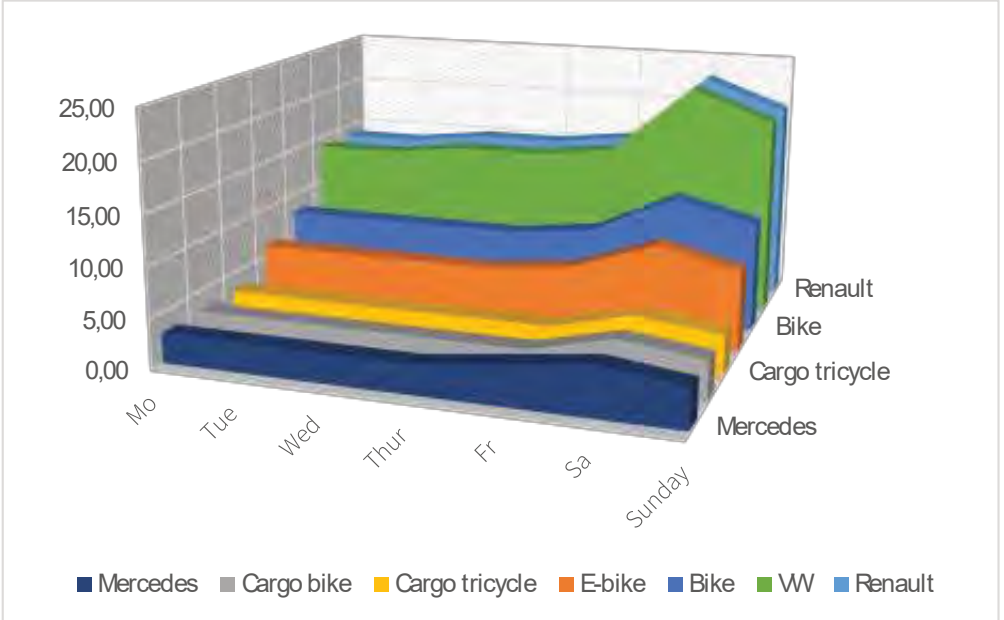
2. Step 4.2

4 Zielbild/ Ergebnis

Vehicle demand by type and day of the week (number) rounded

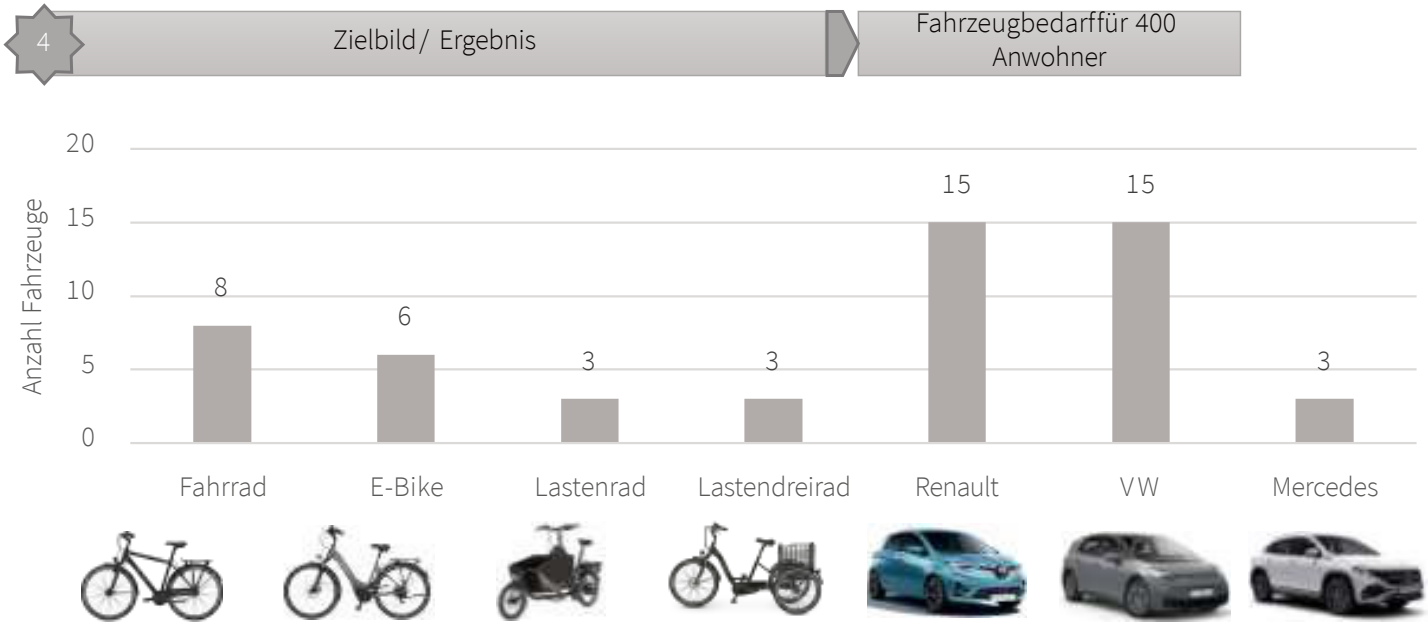
Vehicle	Mo	Tue	Wed	Thur	Fr	Sa	Sunday
Bike	8,00	8,00	8,00	8,00	9,00	13,00	11,00
E-bike	6,00	6,00	6,00	6,00	7,00	10,00	8,00
Cargo bike	3,00	3,00	3,00	3,00	3,00	5,00	4,00
Cargo tricycle	3,00	3,00	3,00	3,00	3,00	5,00	4,00
Renault	14,00	14,00	15,00	15,00	16,00	23,00	20,00
VW	14,00	14,00	15,00	15,00	16,00	23,00	20,00
Mercedes	3,00	3,00	3,00	3,00	4,00	5,00	4,00





Auffällig ist, dass am Wochenende der Fahrzeugbedarf für jede Fahrzeugart deutlich höher ist als unter der Woche. Den Bedarf nach den höchsten Werten zu richten, würde jedoch eine geringe Auslastung nach sich ziehen. Deshalb wurde beschlossen den Bedarf ausschließlich auf Montag bis Freitag auszurichten. Der Durchschnitt dieser Tage bildet somit den endgültigen Bedarf.

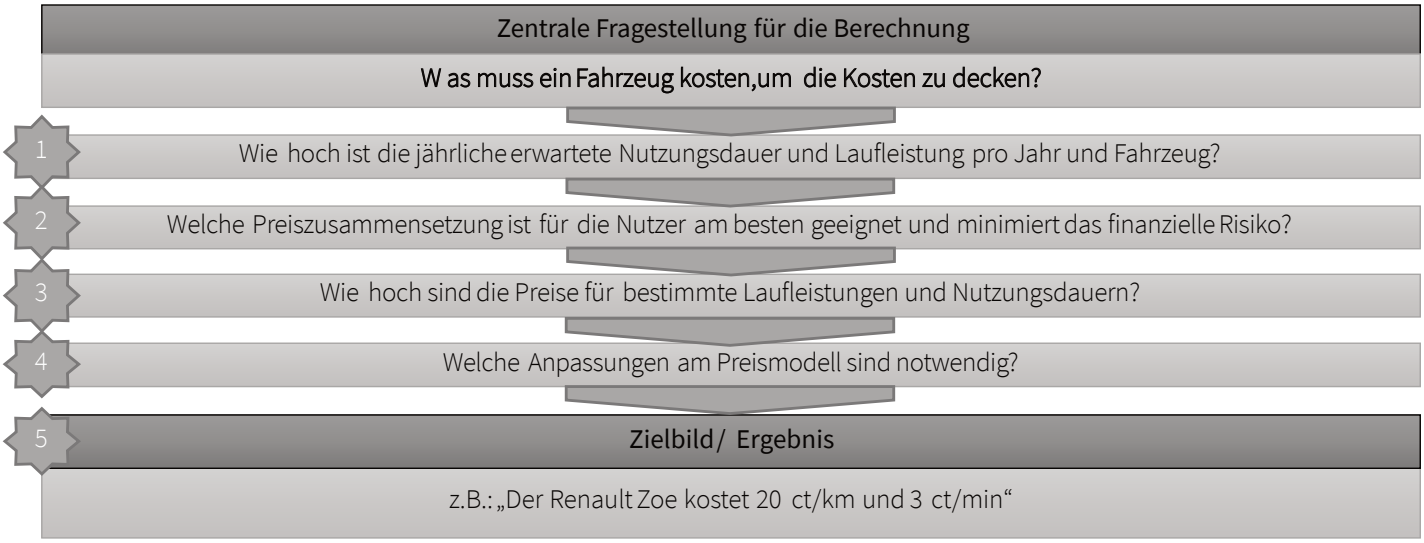
2. Step 4.3


4
Zielbild/ Ergebnis
Fahrzeugbedarffür 400 Anwohner
Anzahl Fahrzeuge
20
15
10
5
0
8
6
3
3
15
15
3
Fahrrad
E-Bike
Lastenrad
Lastendreirad
Renault
VW
Mercedes

SHARING CONCEPT

3. Calculation of the pricing model

3. Calculation of the pricing model - Method



3. Step 1 + 2

1 Wie hoch ist die jährliche erwartete Nutzungsdauer und Laufleistung pro Jahr und Fahrzeug?

Vehicle	Distribution of vehicle use	Average rental time per day and vehicle type (h)		Demand vehicles Mo-Fr according to vehicle type	Trips per day and vehicle type	Journeys per day and vehicle	Duration of use per day and vehicle (h)	Distance per day and vehicle (km)	Period of use per year (h)	Distance per year and vehicle (km)
Bike	16%		49:47	8	21,83	2,73	6:13	27	**2271:45**	**9873**
E-bike	12%		37:20	6	16,37	2,73	6:13	27	**2271:45**	**9873**
Cargo bike	6%		18:40	3	8,19	2,73	6:13	27	**2271:45**	**9873**
Cargo tricycle	6%		18:40	3	8,19	2,73	6:13	27	**2271:45**	**9873**
Renault	28%		88:18	15	38,72	2,58	5:53	54	**2148:47**	**19922**
VW	28%		88:18	15	38,72	2,58	5:53	54	**2148:47**	**19922**
Mercedes	6%		19:37	3	8,60	2,87	6:32	60	**2387:32**	**22136**
			Σ			5			x 365	x 365

2 Fahrten pro Tag (alle) 140,61 3

Average speed bike	15	km/h
Average speed car	32	km/h
Average travel time	39	min
Average rental time	2:16	h
Average distance by bike	09	km
Average distance by car	21	km

1

Jede Fahrzeugart erreicht ungefähr ihre erwartete Laufleistung (10.000 bzw. 20.000 km). Somit können auch die Kilometerpreise anhand der maximalen Laufleistung (10.000 bzw. 20.000 km) gewählt werden. Jede Fahrzeugart übersteigt 2000 Nutzungsstunden pro Jahr. **Annahme:** zur Vereinfachung und um einen gewissen Puffer im Falle geringerer Auslastung zu haben, wird eine standardisierte Nutzungsdauer von 2000 Stunden je Fahrzeugart angenommen. Auf dessen Basis wird jeweils der Nutzungspreis pro Minute berechnet.

2 Welche Preiszusammensetzung ist für die Nutzer am besten geeignet und minimiert das finanzielle Risiko?

Grundsätzliche Überlegungen zur Preisgestaltung:

- Nur bei Autos kann die zurückgelegte Strecke erfasst werden, für Fahrräder ist ein Preis pro Kilometer daher nicht umsetzbar
  - ➢ Fahrradkosten richten sich ausschließlich nach der Leihdauer
- Die durchschnittlich zurückgelegte Entfernung mit dem Auto beträgt 21 km, die Leihdauer jedoch 2:16 h (hohe Ruhezeit während Aktivitäten)
  - ➢ Ein Preismodell, dass sich ausschließlich nach den gefahrenen Kilometern richtet, wäre für den Durchschnittsnutzer daher am günstigsten
  - ➢ **Allerdings:** Ohne Minutenpreis besteht die Gefahr, dass der Nutzer das Auto lange nicht zurückgibt
  - ➢ Gleichmäßige Verteilung des Kilometer- und Minutenpreises notwendig

	Price share mileage	Price share loan period
Renault	**50%**	**50%**
VW	**50%**	**50%**
Mercedes	**50%**	**50%**
bike	**0%**	**100%**
E-Bike	**0%**	**100%**
Cargo bike	**0%**	**100%**
Cargo tricycle	**0%**	**100%**

3. Step 3

3 Wie hoch sind die Preise für bestimmte Laufleistungen und Nutzungsdauern?

$$\frac{Kosten}{km} = \frac{Kosten\ p.a.}{Laufleistung\ p.a.} * \text{Preisanteil Laufleistung}$$

	Mileage p.a.	Time expenditure p.a.	Price share mileage	Price share loan period	TCO over term	Costs / m	Costs / km	Costs / min
Renault Zoe	**20.000 km**	**2.000 h**	**50%**	**50%**	**15.851,92 €**	**660,50 €**	**0,20 €**	**0,03 €**
Mileage 2 Jahre	**18.000 km**	**1.800 h**	**50%**	**50%**	**15.851,92 €**	**660,50 €**	**0,22 €**	**0,04 €**
	16.000 km	**1.600 h**	**50%**	**50%**	**15.851,92 €**	**660,50 €**	**0,25 €**	**0,04 €**
	14.000 km	**1.400 h**	**50%**	**50%**	**15.851,92 €**	**660,50 €**	**0,28 €**	**0,05 €**
	12.000 km	**1.200 h**	**50%**	**50%**	**15.851,92 €**	**660,50 €**	**0,33 €**	**0,06 €**
	10.000 km	**1.000 h**	**50%**	**50%**	**15.851,92 €**	**660,50 €**	**0,40 €**	**0,07 €**
	8.000 km	**800 h**	**50%**	**50%**	**15.851,92 €**	**660,50 €**	**0,50 €**	**0,08 €**
	6.000 km	**600 h**	**50%**	**50%**	**15.851,92 €**	**660,50 €**	**0,66 €**	**0,11 €**
	4.000 km	**400 h**	**50%**	**50%**	**15.851,92 €**	**660,50 €**	**0,99 €**	**0,17 €**
	2.000 km	**200 h**	**50%**	**50%**	**15.851,92 €**	**660,50 €**	**1,98 €**	**0,33 €**

$$\frac{Kosten}{min} = \frac{Kosten\ p.a.}{Leihdauer\ p.a.} * \text{Preisanteil Leihdauer}$$

Erklärung anhand des Renault Zoe. Analog übertragbar auf alle Fahrzeuge.

Die Kosten pro Kilometer und Minute entsprechen den Preisen, die notwendig sind um bis Laufzeitende zu erreichen, dass sich die Gesamtkosten amortisieren.

Wie zuvor berechnet können die Preise auf die maximale Laufleistung (20.000 km) ausgelegt werden.

3. Step 4 + 5

4 Welche Anpassungen am Preismodell sind notwendig?

Anpassungen bei der Preisgestaltung:

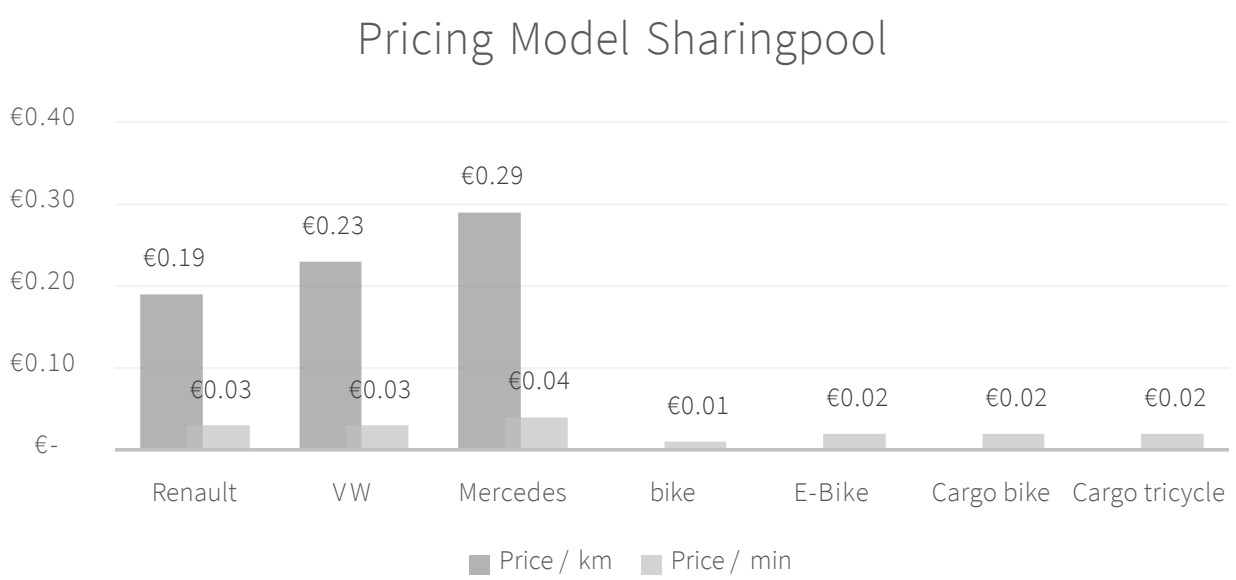
- Wie unten dargestellt sind Preise mit mehreren Nachkommastellen notwendig, damit das Modell exakt kostendeckend ist, für das Sharing-Konzept kommen allerdings nur „normale" Preise (zwei Nachkommastellen) in Frage.
  - Die Preise müssen gerundet werden
  - Da die Autos im Vergleich zu den Fahrrädern deutlich teurer sind, wurde entschieden, dass die Fahrradpreise aufgerundet und die Autopreise abgerundet werden
  - Somit amortisieren die höheren Fahrradkosten die niedrigeren Autokosten
- Die Fahrradpreise sind trotz aufrunden noch sehr günstig und bieten daher Potenzial zur finanziellen Absicherung des Konzepts
  - Die Fahrradpreise werden auf die nächste Preisstufe erhöht (entsprechend 9000 km erwarteter Laufleistung p.a. anstatt 10.000 km)

Price determination

	Expected mileage per a (km)	Price / km	Price / min	Price / km rounded	Price / min rounded
Renault	20000	0,1981 €	0,0330 €	0,19 €	0,03 €
VW	20000	0,2307 €	0,0384 €	0,23 €	0,03 €
Mercedes	20000	0,2966 €	0,0494 €	0,29 €	0,04 €
bike	9000	- €	0,0070 €	- €	0,01 €
E-Bike	9000	- €	0,0142 €	- €	0,02 €
Cargo bike	9000	- €	0,0168 €	- €	0,02 €
Cargo tricycle	9000	- €	0,0149 €	- €	0,02 €

Sollten aufgrund der Absicherungen zum Laufzeitende hin Gewinne entstehen, werden diese mit der Neuanschaffung der Fahrzeuge verrechnet und das Preismodell dementsprechend angepasst.

5 Zielbild / Ergebnis



COSTS FOR THE ELECTRIC INSTALLATION

Investment costs

cost group:		cost:
400	Building costs	785.592,61 €
700	Incidental building costs	42.489,17 €
800	Financing	170.325,82 €
	Total	998.407,60 €

CG 700 incidental biulding costs

cost group		**Cost [€]**	**Total [€]**
711	Project management	24460,14	
713	Project control	4406,42	
715	Award procedure	2697,81	
719	Other for KG 710	1798,54	
710	**Client tasks**		**33362,91**
742	Technical equipment	3372,26	
740	**Specialist planning**		**3372,26**
769	Other for KG 760	250,00	
760	**General ancillarybuildingcosts**		**250,00**
799	Other for KG 790	5504,00	
790	**Other ancillarybuildingcosts**		**5504,00**
700	**Incidentalbuildingcosts**		**42489,17**

CG 800 Financing

cost group		**cost [€]**	**Total [€]**
810	Incidental financing costs	1095,00	
820	Interest on borrowed capital	150222,99	
830	Interest on equity	19007,82	
800	**Financing**		**170325,82**

CG 830 Interest on equity

Total:	828.081,78 €			
Equity:	30%	corresponds:	248.424,53 €	
Debt financing:	70%	corresponds to:	579.657,25 €	580.000,00 €
Attachment Duration:	10	Years		
Equityinterest rate:	0,74%	10 Annual average		

date	calcul. Interest:	calcul. Equity
31.12.21	- €	248.424,53 €
31.12.22	1.838,34 €	250.262,88 €
31.12.23	1.851,95 €	252.114,82 €
31.12.24	1.865,65 €	253.980,47 €
31.12.25	1.879,46 €	255.859,93 €
31.12.26	1.893,36 €	257.753,29 €
31.12.27	1.907,37 €	259.660,66 €
31.12.28	1.921,49 €	261.582,15 €
31.12.29	1.935,71 €	263.517,86 €
31.12.30	1.950,03 €	265.467,89 €
31.12.31	1.964,46 €	267.432,36 €
Total	**19.007,82 €**	

BKI 2021:	1st quarter, corrected with construction price index 2021, 3rd quarter

BGF	117,92	m²
Regional factor:	1,010	Nürnberg Stadt
Cost inkl. Vat:	19	%

Construction Price Index 2015	1
Construction price index 2021, 1st quarter:	1,208
Construction Price Index 2021, 3rd quarter:	1,296

cost group		BGF [m²]	KKW [€]	Cost [€]	Total [€]	BKI Seite:
442	Self-supply systems	117,92	121,77	14358,91		205
444	Low-voltage installation systems	117,92	40,77	4807,39		205
445	Lighting systems	117,92	13,95	1644,63		205
446	Lightning protection and earthing systems	117,92	3,11	366,88		205
440	Electrical system	117,92	179,59		21177,81	205
457	Data transmission networks	117,92	6,44	759,06		205
450	Telecommunications and information technology equipment	117,92	6,44		759,06	205
491	Site equipment	117,92	0,86	101,21		207
490	Other measures for technical installations	117,92	0,86		101,21	207
400	Building- Technical plant	117,92	Construction Price Index 2021, 3rd quarte		22038,08	

Total incl. regianal factor, per HDU; gross:	22.258,46 €		Net:	18.704,59 €
Total incl. regianal factor, 42x HDU; Gross:	934.855,21 €		Net:	785.592,61 €

Maintenance costs

Discount rate q:	1,0194
Price increase r:	1,0320
Period under review T in years:	50
Present value factor b:	67,32
Useful life of electrical installation in years:	25

Cost group		Net investment costs	Useful life	Present value of replacement purchase
440	Electrical installations	16.934,90 €	25	23.022,86 €
450	Telecommunications and information technology equipment	594,55 €	25	808,29 €
400	**Buildingtechnical installations**		**per HDU**	**23.831,15 €**
			42xHDU	**1.000.908,49 €**
			Present value of replacement purchase per year	40.036,34 €

Component	Every10 years	every15 years	Costs[€]	Cash value 1. exchange
Sockets	1		32,19 €	36,39 €
Light switch	3		80,46 €	90,98 €
Power socket Socket		1	43,99 €	52,89 €
Switchingrelaymin 100000 operations		5	193,11 €	232,19 €
MCB	2		38,62 €	43,67 €
RCD		1	77,25 €	92,87 €
3-pole cable 15lfm		1	59,54 €	71,59 €

Cash value 2. exchange	Cash value 3. exchange	Cash value 4. exchange	Total present value
41,15 €	46,53 €	52,61 €	176,68 €
102,87 €	116,32 €	131,52 €	441,70 €
63,59 €	76,45 €		192,93 €
279,17 €	335,65 €		847,00 €
49,38 €	55,83 €	63,13 €	212,01 €
111,67 €	134,26 €		338,80 €
86,08 €	103,49 €		261,16 €
		per HDU	**2.470,28 €**
		42x HDU	**103.751,85 €**

FINANCING PLAN

Maintenance costs = 150,000€

Capital	
	Input
Acquisition costs	0,00
Renovation costs	15.098.328,00
Incidental building costs (15%)	2.264.749,20
Total capital requirement	17.363.077,20
Equity capital Siedlungswerk	500.000,00
Equity capital	1.500.000,00
Total equity capital	2.000.000,00
Debt capital requirement	15.363.077,20
Credit amount credit 1	15.363.077,20
Nominal interest credit 1	0,01

Repayment loan 1

Year	Credit amount at the beginning of the year	Annuity	Interest rate	Repayment	Loan amount year end	Remaining cash flow
1	15.363.077,20	577.890,00	153.630,77	424.259,23	14.938.817,97	0,00
2	14.938.817,97	577.890,00	149.388,18	428.501,82	14.510.316,15	0,00
3	14.510.316,15	577.890,00	145.103,16	432.786,84	14.077.529,31	0,00
4	14.077.529,31	577.890,00	140.775,29	437.114,71	13.640.414,61	0,00
5	13.640.414,61	577.890,00	136.404,15	441.485,85	13.198.928,75	0,00
6	13.198.928,75	577.890,00	131.989,29	445.900,71	12.753.028,04	0,00
7	12.753.028,04	577.890,00	127.530,28	450.359,72	12.302.668,32	0,00
8	12.302.668,32	577.890,00	123.026,68	454.863,32	11.847.805,00	0,00
9	11.847.805,00	577.890,00	118.478,05	459.411,95	11.388.393,05	0,00
10	11.388.393,05	577.890,00	113.883,93	464.006,07	10.924.386,98	0,00
11	10.924.386,98	577.890,00	109.243,87	468.646,13	10.455.740,85	0,00
12	10.455.740,85	577.890,00	104.557,41	473.332,59	9.982.408,26	0,00
13	9.982.408,26	577.890,00	99.824,08	478.065,92	9.504.342,35	0,00
14	9.504.342,35	577.890,00	95.043,42	482.846,58	9.021.495,77	0,00
15	9.021.495,77	577.890,00	90.214,96	487.675,04	8.533.820,73	0,00
16	8.533.820,73	577.890,00	85.338,21	492.551,79	8.041.268,93	0,00
17	8.041.268,93	577.890,00	80.412,69	497.477,31	7.543.791,62	0,00
18	7.543.791,62	577.890,00	75.437,92	502.452,08	7.041.339,54	0,00
19	7.041.339,54	577.890,00	70.413,40	507.476,60	6.533.862,93	0,00
20	6.533.862,93	577.890,00	65.338,63	512.551,37	6.021.311,56	0,00
21	6.021.311,56	577.890,00	60.213,12	517.676,88	5.503.634,68	0,00
22	5.503.634,68	577.890,00	55.036,35	522.853,65	4.980.781,03	0,00
23	4.980.781,03	577.890,00	49.807,81	528.082,19	4.452.698,84	0,00
24	4.452.698,84	577.890,00	44.526,99	533.363,01	3.919.335,82	0,00
25	3.919.335,82	577.890,00	39.193,36	538.696,64	3.380.639,18	0,00
26	3.380.639,18	577.890,00	33.806,39	544.083,61	2.836.555,57	0,00
27	2.836.555,57	577.890,00	28.365,56	549.524,44	2.287.031,13	0,00
28	2.287.031,13	577.890,00	22.870,31	555.019,69	1.732.011,44	0,00
29	1.732.011,44	577.890,00	17.320,11	560.569,89	1.171.441,56	0,00
30	1.171.441,56	577.890,00	11.714,42	566.175,58	605.265,97	0,00
31	605.265,97	577.890,00	6.052,66	571.837,34	33.428,63	0,00
32	33.428,63	577.890,00	334,29	33.428,63	0,00	544.127,08
33	0,00	577.890,00	0,00	0,00	0,00	577.890,00
34	0,00	577.890,00	0,00	0,00	0,00	577.890,00
35	0,00	577.890,00	0,00	0,00	0,00	577.890,00
36	0,00	577.890,00	0,00	0,00	0,00	577.890,00
37	0,00	577.890,00	0,00	0,00	0,00	577.890,00
38	0,00	577.890,00	0,00	0,00	0,00	577.890,00
39	0,00	577.890,00	0,00	0,00	0,00	577.890,00
40	0,00	577.890,00	0,00	0,00	0,00	577.890,00

FINANCING PLAN

Rent increase from 9,50€ to 10,50€

Current payments			
Rental income annually	804.510,00		
Maintenance costs annually	105.000,00		
Cash inflow	699.510,00		

Capital

Input	
Acquisition costs	0,00
Renovation costs	15.098.328,00
Incidental building costs (15%)	2.264.749,20
Total capital requirement	17.363.077,20
Equity capital Siedlungswerk	500.000,00
Equity capital	1.500.000,00
Total equity capital	2.000.000,00
Debt capital requirement	15.363.077,20
Credit amount credit 1	15.363.077,20
Nominal interest credit 1	0,01

Repayment loan 1

Year	Credit amount at the beginning of the year	Annuity	Interest rate	Repayment	Loan amount year end	Remaining cash flow
1	15.363.077,20	699.510,00	153.630,77	545.879,23	14.817.197,97	0,00
2	14.817.197,97	699.510,00	148.171,98	551.338,02	14.265.859,95	0,00
3	14.265.859,95	699.510,00	142.658,60	556.851,40	13.709.008,55	0,00
4	13.709.008,55	699.510,00	137.090,09	562.419,91	13.146.588,64	0,00
5	13.146.588,64	699.510,00	131.465,89	568.044,11	12.578.544,52	0,00
6	12.578.544,52	699.510,00	125.785,45	573.724,55	12.004.819,97	0,00
7	12.004.819,97	699.510,00	120.048,20	579.461,80	11.425.358,17	0,00
8	11.425.358,17	699.510,00	114.253,58	585.256,42	10.840.101,75	0,00
9	10.840.101,75	699.510,00	108.401,02	591.108,98	10.248.992,77	0,00
10	10.248.992,77	699.510,00	102.489,93	597.020,07	9.651.972,69	0,00
11	9.651.972,69	699.510,00	96.519,73	602.990,27	9.048.982,42	0,00
12	9.048.982,42	699.510,00	90.489,82	609.020,18	8.439.962,25	0,00
13	8.439.962,25	699.510,00	84.399,62	615.110,38	7.824.851,87	0,00
14	7.824.851,87	699.510,00	78.248,52	621.261,48	7.203.590,39	0,00
15	7.203.590,39	699.510,00	72.035,90	627.474,10	6.576.116,29	0,00
16	6.576.116,29	699.510,00	65.761,16	633.748,84	5.942.367,45	0,00
17	5.942.367,45	699.510,00	59.423,67	640.086,33	5.302.281,13	0,00
18	5.302.281,13	699.510,00	53.022,81	646.487,19	4.655.793,94	0,00
19	4.655.793,94	699.510,00	46.557,94	652.952,06	4.002.841,88	0,00
20	4.002.841,88	699.510,00	40.028,42	659.481,58	3.343.360,30	0,00
21	3.343.360,30	699.510,00	33.433,60	666.076,40	2.677.283,90	0,00
22	2.677.283,90	699.510,00	26.772,84	672.737,16	2.004.546,74	0,00
23	2.004.546,74	699.510,00	20.045,47	679.464,53	1.325.082,21	0,00
24	1.325.082,21	699.510,00	13.250,82	686.259,18	638.823,03	0,00
25	638.823,03	699.510,00	6.388,23	638.823,03	0,00	54.298,74
26	0,00	699.510,00	0,00	0,00	0,00	699.510,00
27	0,00	699.510,00	0,00	0,00	0,00	699.510,00
28	0,00	699.510,00	0,00	0,00	0,00	699.510,00
29	0,00	699.510,00	0,00	0,00	0,00	699.510,00
30	0,00	699.510,00	0,00	0,00	0,00	699.510,00
31	0,00	699.510,00	0,00	0,00	0,00	699.510,00
32	0,00	699.510,00	0,00	0,00	0,00	699.510,00
33	0,00	699.510,00	0,00	0,00	0,00	699.510,00
34	0,00	699.510,00	0,00	0,00	0,00	699.510,00
35	0,00	699.510,00	0,00	0,00	0,00	699.510,00
36	0,00	699.510,00	0,00	0,00	0,00	699.510,00
37	0,00	699.510,00	0,00	0,00	0,00	699.510,00
38	0,00	699.510,00	0,00	0,00	0,00	699.510,00
39	0,00	699.510,00	0,00	0,00	0,00	699.510,00
40	0,00	699.510,00	0,00	0,00	0,00	699.510,00

Angebots-LV

Projekt

2204

HDU-Aufstockung

Bauvorhaben

Aufstockung HDU
42 Wohneinheiten
Regensburgerstraße 143-159
90478 Nürnberg

Bauherr

Frau Decathlon

Bauleitung

Planungsbüro KGWBR
Hochschulstraße 1
83024 Rosenheim

Leistung (LV)

01

Elektroinstallation

Ausführungsbeginn	Ausführungsende
02.05.2022	**27.07.2022**

Kostenaufstellung

- **Gesamt, Netto:**	**1.017.918,59 EUR**
- zzgl. MwSt:	193.404,53 EUR
- **Gesamt, Brutto:**	**1.211.323,12 EUR**

Gezeichnet

(Kostenaufstellung erstellt von ...)

Seiten ohne Anlage(n)

Seiten: 78

Bepreistes-LV, Leistungsverzeichnis

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Angebots-LV

Projekt (2204)
HDU-Aufstockung

Leistung (LV)
01 Elektroinstallation

Bauvorhaben
Aufstockung HDU
42 Wohneinheiten
Regensburgerstraße 143-159
90478 Nürnberg

Bauherr

Frau Decathlon	Telefon	Ansprechpartner: ...
	Fax	Planungsbüro KGWBR

Bieter / Ausschreibung

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Ansprechpartner / Bemerkung

Sie haben noch Fragen? (benedikt.schuhbeck@stud.th-rosenheim.de)

Angebotssumme in EUR

Angebotssumme, Netto:	1.017.918,59 €	1.017.918,59 €
zzgl. MwSt. (19,0 %):	193.404,53 €	193.404,53 €
Angebotssumme, Brutto:	**1.211.323,12 €**	**1.211.323,12 €**
	Angebotsabgabe	Geprüft

ZEUS Elektroinstallationen
Wir bringen Ihnen die Freude schöner Gästerfunken
Zeus Elektroinstallation GmbH
Bergstraße 1, 90403 Nürnberg
Tel.: +49 911 XXXXXX – 0
E-Mail: info@ZeusElektroinstallation.de

Nürnberg, 08.12.2021
Ausschreibender - Ort, Datum

Stempel

Nürnberg, 08.12.2021
Angebotssumme nachgeprüft

Inhaltsverzeichnis

01 LV Elektroinstallation

Leistungsverzeichnis

Leistung (Titel)

01

Potentialausgleich

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
01 Titel Potentialausgleich

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Potentialausgleich

Der Potentialausgleich wird gem. allen geltenden Normen und Richtlinien fachgerecht ausgeführt. Alle Kleinteile die zur fix und fertigen Montage gehören, in den Einzelpositionen aber nicht erwähnt werden, sind in die Einzelpreise der vorhandenen Positionen einkalkuliert.
Es werden alle metallenen Bauteile und Rohrleitungen von Fremdgewerken in den Potentialausgleich eingebunden. Alle Leitungen an der Schiene werden dauerhaft beschriftet.
Der Mindestquerschnitt für Potentialausgleichsleiter beträgt bei Kupfer 6mm², bei Aluminium 16mm² und bei Stahl 50mm².

01.1 **Potentialausgleichsschiene** KG: -

Potentialausgleichsschiene 188mm

Anschlussmöglichkeiten:
- 7x ein- oder mehrdrähtige Leitungen bis 25 mm² oder feindrähtige Leitungen bis 16 mm²
- 1x Rundleiter Rd 8-10
- 1x Flachband bis FL30 oder Rundleiter Rd 8-10

Fußplatte und Abdeckhaube aus Polystyrol grau,
Abdeckhaube plombierbar / beschriftbar,
Version: schwarz = UV-beständig für den Außenbereich,
Kontaktleiste aus Messing vernickelt,
Schrauben und Überleger aus Stahl, galvanisch verzinkt.

Blitzstromtragfähig 100 kA (10/350)

Farbe: grau
Gewicht: 23 kg/100 St.

Fabrikat: OBO BETTERMANN
Typ: 1809
Art.-Nr.: 5015073

liefern, montieren und betriebsfertig anschließen.

42 St EP 76,38 GP 3.207,96

01.2 **Aderleitung H07-U 1x16mm2** KG: -

Aderleitung H07-U 1x16mm2, nach VDE 0285-525-2-31.

Bestimmt für die Verlegung in Rohren auf, in und unter Putz sowie in geschlossenen Installationskanälen.
Für die innere Verdrahtung von Geräten, Schaltanlagen und Verteilern sowie für geschützte Verlegung in und an Leuchten mit einer Nennspannung bis 1000 V Wechselspannung oder einer Gleichspannung bis 750 V gegen Erde.

- Fortsetzung auf nächster Seite -

Übertrag: 3.207,96

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
01 Titel Potentialausgleich

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 3.207,96

Merkmal-Bezeichnung Ausprägung
Leiter-Material Kupfer
Leiter-Form rund
Leiter-Klasse Kl.1 eindrähtig
Ader-Zahl 1
Werkstoff der Aderisolation Polyvinylchlorid (PVC)
Zul. max. Leitertemperatur 70 °C
Schutzleiter Nein
Schirm Nein
Bewehrung/Armierung ohne
Mantelmaterial ohne
Mantel-Farbe ohne

Brandverhaltensklasse nach EN 13501-6 Eca
Halogenfrei nach EN 60754-1/2
Flammwidrig nach EN 60332-1-2
Raucharm nach EN 61034-2 Nein
Zul. Kabelaußentemperatur bei Montage/Handling 5 <=> 70 °C
Zul. Kabelaußentemperatur nach Montage ohne Erschütterung
-40 <=> 70 °C
Nennspannung U0 450 V
Nennspannung U 750 V
Biegeradius min. 4 x Außen-Ø
Zul. Kurzschlusstemperatur 160 °C

Fabrikat: LAPP Kabel

liefern, montieren und betriebsfertig anschließen.

126 m EP 9,50 GP 1.197,00

01.3 **Aderendhülse 16 mm2** KG: -

Aderendhülse 16 mm2 nach DIN 46228 Teil 1

Für fein- und feinstdrähtige Leiter, z. B. nach DIN EN 60228 Kl. 5 und 6.
Spleißfreie Kabeleinführung durch aufgeweitete Hülse.
Aus Kupfer, galvanisch verzinnt zum Schutz gegen Korrosion.

Fabrikat: Klauke
Art.-Nr.: 47712

liefern, montieren und betriebsfertig anschließen.

84 St EP 1,80 GP 151,20

Summe Titel 01

Potentialausgleich, Netto: 4.556,16 EUR

Leistungsverzeichnis

Leistung (Titel)

02

Zählerschrank Wohnungen und Bestückung

Angebots-LV

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Zählerschrank

Der Zählerschrank wird als fabrikneue Energie-Schaltgerätekombination hergestellt, und als allseitig geschlossener Stahlblech- Schrank mit Türschloss und zwei Schlüsseln ausgeführt.
Die Schutzart der Schaltanlage entspricht den örtlichen Gegebenheiten und den behördlichen Vorschriften.

Eine korrekte Zuordnung des Zählerfeldes zur Kundenanlage ist sichergestellt. Die Zuordnung der Zählerfelder zur jeweiligen Kundenanlage ist eindeutig und dauerhaft gekennzeichnet.

Die stromführenden Komponenten des Zählerschrankes sind anhand des vorgeschalteten Sicherungsorganes dimensioniert

Es ist eine Platzreserve von mindestens einem Zählerfeld vorgesehen.

Der Verdrahtungsaufwand ist in den Positionen einkalkuliert und wird geliefert und montiert.

02.1 **Zählerschrank, 1100x800x205 mm, universal Z**
Grundposition 001.0

Zählerschrank, 1100x800x205 mm, 3 Felder, Schutzklasse II

Schrankgehäuse nach DIN VDE 0603-1, Maßnorm DIN 43870 zur Aufputz-, Unterputz- oder teilversenkter Montage.

Zum Aufbau einer Zählerverteileranlage bis 355 A, Bemessungsspannung 230/400 V 50 Hz.
Schutzart IP31 (IP44/IP54 nach DIN VDE 0470-1), Schutzklasse II schutzisoliert, Schutzart IP3X hinter der Tür.
Bestehend aus Schrank mit Tür aus pulverbeschichtetem, eingebranntem, stabil profiliertem 1 mm dickem Stahlblech.
Innenauskleidung komplett aus Kunststoff.
Leitungseinführungen oben und unten durch eingebaute Kunststoffflanschplatten, rückseitige Vorprägung im Kunststoffteil und seitlich eingebaute Kunststoff-Flanschplatten im Bereich des NAR (geeignet als Sammelschienendurchführung), des RfZ (nur bei Bauhöhe 1100 mm) und des AAR.
Tür frontbündig mit innenliegenden, justierbaren Scharnieren, wahlweise rechts oder links anschlagbar mit 110° Öffnungswinkel. Türverschluss mit Vorreiber, ab Breite 800 mm und bei allen Schränken ab einer Höhe von 1250 mm mit Stangenverschluss mit Dreipunktschließung. Türverschluss durch andere Schließungen austauschbar.
Schrank nebeneinander und übereinander anflanschbar.

Hinweis: Bei einer Schrank-Schrank-Verbindung immer einen Verbindungssatz verwenden (Zubehör). Im AAR-Bereich kann die Kunststoff-Flanschplatten entfernt werden und optional eine SCHUKO-Steckdose oder eine CEE-Steckdose eingebaut

- Fortsetzung auf nächster Seite -

Übertrag: 0,00

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 0,00

werden.

Höhe installiertes Produkt:	1100 mm
Breite installiertes Produkt:	800 mm
Tiefe installiertes Produkt:	205 mm
Anzahl Felder:	3
Anzahl der Verteilerreihen:	21
Schutzart:	IP44
Schutzklasse:	Schutzklasse II
Anzahl der Schlösser:	1
Türschliessungstyp:	Klappgriff mit Vorreiber und Stangenverschluß
Farbe:	reinweiß RAL 9010

Fabrikat: Hager
Typ: Zählerschrank, univers Z
Art.-Nr.: ZB33S

liefern, montieren und betriebsfertig anschließen.

42 St EP 1.033,71 GP 43.415,82

02.2 **Zählerschrank, 1100x800x215, ComfortLine**
Wahlposition 001.1

Zählerschrank, 1100x800x215, ComfortLine

Baureihe ComfortLine, Ausbauschrank, mit BKE-I, Stecktechnik.

Montageart:
Aufputz, Unterputz, teilversenkt, für den Innenbereich,

Mit Tür, mit VDE-Prüfzeichen, QMS Rasttechnik für einfaches Einrasten der Einbaufelder, integrierte Leitungsführungskanäle für das Messystem der Zukunft, sichere 3-Punkt-Verriegelung, Gehäuse aus Stahlblech, Tür aus Stahlblech, mit Standardverschluss, Türöffnungswinkel 130 Grad, Türanschlag rechts und links, Rückwand aus Metall.
Leitungseinführung oben über Membranflansch montiert, seitlich über Flanschöffnung vorgeprägt, Rückwand Kabeleinführung vorgeprägt, Zählerplatz verdrahtet, unterer Anschlussraum Zählerplatz: mit Sammelschiene, oberer Anschlussraum Zählerplatz: mit integrierter Hauptleitungsabzweigklemme, Abdeckungen aus Kunststoff, 90 Grad Druck-Drehverschluss.

Geltende Normen: DIN VDE 0603-1, DIN 43870-1, DIN 43870-2, DIN 43870-3, VDE-AR-N 4100,

Pulverbeschichtet, Gehäuse in RAL 9016

Baureihe:	ComfortLine A Solutions
Höhe des Produkts:	1100 mm

- Fortsetzung auf nächster Seite -

Übertrag: 43.415,82

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 43.415,82

Breite des Produkts: 800 mm
Tiefe des Produkts: 215 mm

Fabrikat: ABB STRIEBEL & JOHN
Typ: AA37A1SA
Art.-Nr.: 2CPX054295R9999

liefern, montieren und betriebsfertig anschließen.

42 St EP 1.224,71 - Nur EP -

02.3 **Komplettfeld, 1050x250 mm, für Universal Z**
Grundposition 002.0

Komplettfeld, 1050x250 mm, BKE-I, 1 Feld, Steuerklemme 7-pol., HLAK 5-pol.

In Kombination mit Zählerschrank Universal Z

Komplettfeld / Einbausatz für eHZ zum Aufbau von Zählerplätzen nach DIN 43870, Schnellmontage im Schrank durch Rast-System, bestückt und verdrahtet nach VNB TAB-Bestimmungen für eHZ-Zählerplätze nach DIN VDE 603-1 (VDE 0603-1).

Oberer Anschlussraum:
1-reihig Höhe 150 mm mit einer Hutschiene, 2-reihig Höhe 300 mm mit zwei Hutschienen, bestückt mit Hauptleitungsabzweigklemmen 3-/4- oder 5-polig, fingersicher nach BGVA3.
Zählerfelder mit integrierter Befestigungs- und Kontaktiereinrichtung (BKE-I) für eHZ, zum Einbau gemäß DIN 43870, eHZ-Zählertragplatte mit integriertem Zusatzraum (für Kommunikations- und Steuergeräte).

Zusatzraum:
1-feldig, Höhe 150 mm, mit Abdeckung geschlossen, Vorprägungen für 12 PLE, plombierbar, mit Hutschiene 12 PLE, Öffnungen für Leitungsführung.

Unterer Anschlussraum:
Höhe 300 mm bestückt mit Hutschiene oder CU-Sammelschienen, 12 x 5 mm, 4-polig / 5-polig.

Höhe installiertes Produkt: 1050 mm
Breite installiertes Produkt: 250 mm
RAL Farbnummer: 9010
Zähleraufnahme: eHZ System
Anzahl Zählerplätze = 63 A: 2
Anzahl Zählerplätze >= 80 A: 0
Anzahl Reserveplätze: 1
Anzahl Zählerfelder (Einbausätze): 1

- Fortsetzung auf nächster Seite -

Übertrag: 43.415,82

Angebots-LV

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 43.415,82

Anzahl 3-Punkt-Aufnahmen für SG/TRE: 0
Anzahl Verteilerfelder: 0
Anzahl der Verteilerreihen: 0
Mit Multimediafeld: nein
Anzahl Felder: 1
Netzform: TT/TN-S
Polanzahl Verdrahtung: 5-polig
Sammelschienendicke: 5 mm
Sammelschienenhöhe: 12 mm
Sammelschieneneinspeiseklemmen enthalten: nein
Ausstattung Zählerplatz: ohne BKE-Datenschnittstelle
Ausstattung NAR Zählerfeld: mit Sammelschienen 5-polig
Hauptgerät NAR Zählerfeld: für Einbau von selektivem Hauptleitungsschutzschalter
Zusatzgerät NAR Zählerfeld: leer
Hauptgerät AAR Zählerfeld: Hauptleitungsabzweigklemme 5-polig berührungssicher bis 25mm²
Zusatzgerät AAR Zählerfeld: leer
PE/N-Klemmen AAR Zählerfeld: leer
Zusatzgerät NAR SG/TRE-Feld: Steuerleitungsklemme 7-polig mit Federklemme
Ausstattung AAR SG/TRE-Feld: ohne Bestückung
Anzahl RJ45-Schnittstellen: 0

Fabrikat: Hager
Typ: Komplettfeld, univers Z
Art.-Nr.: ZH3ET22

liefern, montieren und betriebsfertig anschließen.

42 St EP 373,66 GP 15.693,72

02.4 **Komplettfeld, 1050x250mm, für ComfortLine**
Wahlposition 002.1

Komplettfeld, passend für Baureihe: ComfortLine

In Kombination mit Zählerschrank ComfortLine

Komplettfeld, mit BKE-I, geltende Normen: DIN VDE 0603-1, DIN 43870-1, DIN 43870-2, DIN 43870-3, VDE-AR-N 4100.

Zählerplatz verdrahtet, Netzsystem TN-S 5-polig, mit Kanal für Steuerzwecke, unterer Anschlussraum Zählerplatz: mit Sammelschiene, vorbereitet für SH-Schalter, Abdeckungen aus Kunststoff, 90 Grad Druck-Drehverschluss, RAL 7035.

Baureihe: ComfortLine
Höhe des Produkts: 1050 mm
Breite des Produkts: 250 mm
Tiefe des Produkts: 160 mm

- Fortsetzung auf nächster Seite -

Übertrag: 59.109,54

Angebots-LV

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 59.109,54

Fabrikat: ABB STRIEBEL & JOHN
Typ: FB17XM2
Art.-Nr.: 2CPX054197R9999

liefern, montieren und betriebsfertig anschließen.

42 St EP 502,35 - Nur EP -

02.5 **Verteilerfeld, 1050x250, für Universal Z**
Grundposition 003.0

Verteilerfeld, 1050x250, 5-reihig, 1 Feld

In Kombination mit Zählerschrank Universal Z

Komplettfeld / Einbausatz zum Einbau in Zählerschränken
System univers Z bestehend aus Verteilerfeld,
APZ Feld und Zusatzeinrichtungen.

Als Stromkreisverteilung, nach DIN 43870 zur Aufnahme von Modulargeräten (REG Geräte) auf DIN-Hutschiene sowie Gerätekomponenten für APZ Anwendung (Anschlusspunk Zählerplatz).
Schnellmontage im Schrank durch Rast-System ohne Werkzeug bestehend aus 250 mm breitem Feld mit Traggerüst aus profiliertem Stahlblech, mit profilierten DIN Hutschienen 35x7,5 mm, mit fingersicheren PE/N-Klemmen in Stecktechnik, waagerecht montiert im oberen Verteiler, mit gelochter Montageplatte (Lochung 3,2 mm) und profilierter DIN Hutschiene 35x7,5 mm, Stahlblech verzinkt.
Beiliegende RJ45 Buchse. APZ aufgebaut als vollständiges Kunststoffgehäuse mit seitlichen Leitungseinführungen im plombierten Bereich.
Universalhaltebügel mit schraubloser Befestigung von Gerätekomponenten direkt auf dem Lochblech (einhängbar).
Berührungsschutzabdeckungen aus Kunststoff mit Vierpunkt-Befestigung, serienmäßig plombierbar und integriertem Griff.

Technische Merkmale

Höhe installiertes Produkt	1050 mm
Breite installiertes Produkt	250 mm
Tiefe installiertes Produkt	96 mm
RAL Farbnummer	9010
Anzahl der Verteilerreihen	5
Schutzart:	IP00

- Fortsetzung auf nächster Seite -

Übertrag: 59.109,54

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	59.109,54
	Fabrikat: Hager Typ: Verteilerfeld, univers Z Art.-Nr.: ZU37VT5APZ2 liefern, montieren und betriebsfertig anschließen.	42 St	EP 209,69	GP 8.806,98
02.6 Wahlposition 003.1	**Verteilerfeld, 1050x250, für ComfortLine** Verteilerfeld, 1050x250, für ComfortLine In Kombination mit Zählerschrank ComfortLine passend für die Baureihe: ComfortLine, Leerfeld, geltende Normen: DIN VDE 0603-1, DIN 43870-1, DIN 43870-2 Abdeckungen aus Kunststoff, 90 Grad Druck-Drehverschluss, RAL 7035 Baureihe: ComfortLine Höhe des Produkts: 1050 mm Breite des Produkts: 250 mm Tiefe des Produkts: 160 mm Fabrikat: ABB STRIEBEL & JOHN Typ: FV17 Art.-Nr.: 2CPX054002R9999 liefern, montieren und betriebsfertig anschließen.	42 St	EP 176,01	- Nur EP -
02.7 Grundposition 004.0	**Komplettfeld Multimedia, 1050x250 mm, für Universal Z** Komplettfeld Multimedia, 1050mm,1 Feld, mit 6xPatchmodulen RJ45 In Kombination mit Zählerschrank Universal Z Einbausatz für Multimediaanwendungen zum Einbau in Zählerschranksystem durch werkzeuglose Schnellmontage nach Maßnorm DIN 43870. Vormontierter Einbausatz bestehend aus Traggerüst mit Tragschienen, gelochte Montageplatte und montiertes Patchpanel isoliert aufgeschraubt für 12-Ports (1-feldig) bzw. für 24-Ports (2-feldig) mit Bezeichnungsstreifen. Beigelegt sind: 6 Stück bzw. 12 Stück geschirmte Datenmodule RJ45 Kat. 6 (500 MHz), 3-fach Schutzkontaktsteckdosen (90 Grad drehbar) zum Leitungsanschluss über Steckklemmen,			

- Fortsetzung auf nächster Seite -

Übertrag: 67.916,52

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 67.916,52

Multimedia-Gerätehalter für VDI-Komponenten und Kabel-Halteklammern.

Hinweis: Vom Patchpanel ist eine Leitung zur Potentialausgleichsschiene (Funktionspotentialausgleich nach DIN EN 50310 - VDE 0800-2-310) miteinander zu verbinden (nicht enthalten).
Abschottungen vom Multimediafeld neben anderen Einbausätzen sind nach Anwendung einzubauen (nicht enthalten).

Höhe installiertes Produkt: 1050 mm
Breite installiertes Produkt: 250 mm
Anzahl Felder: 1
Farbe: reinweiß RAL 9010

Fabrikat: Hager
Typ: Komplettfeld Multimedia, universZ
Art.-Nr.: UF311NW

liefern, montieren und betriebsfertig anschließen.

42 St EP 342,99 GP 14.405,58

02.8 **Komplettfeld Multimedia, 1050x250 mm, für ComfortLine**
Wahlposition 004.1

Komplettfeld Multimedia, 1050x250 mm, für ComfortLine

In Kombination mit Zählerschrank ComfortLine

Für Kommunikationstechnik, geltende Normen: DIN VDE 0603-1.

Baureihe: 1MM
Bauhöhe: 3
Rastereinheiten (RE): 3
Platzeinheiten PLE: 84
Feldbreite: 1
Höhe des Produkts: 1050 mm
Breite des Produkts: 250 mm
Tiefe des Produkts: 120 mm

Fabrikat: ABB STRIEBEL & JOHN
Typ: 1MMC33
Art.-Nr.: 2CPX037466R9999

liefern, montieren und betriebsfertig anschließen.

42 St EP 198,87 - Nur EP -

Übertrag: 82.322,10

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	82.322,10
02.9	**Sammelschienenverbinder, 5-polig, CU 12x5mm, 250A** KG: -			
	Sammelschienenverbinder, 5-polig, CU 12x5mm, 250A Ausführung: flach Nennstrom: 250 A Polanzahl: 5 P Fabrikat: Hager Art.-Nr.: ZM15F liefern, montieren und betriebsfertig anschließen.	**42 St**	EP 54,74	GP 2.299,08
02.10	**RJ45-Buchse in Patch/Patch für WAN-Anwendung** KG: -			
	RJ45-Buchse in Patch/Patch Ausführung 180° für WAN-Anwendung IP20, CAT 6A Typ: RJ45 8(8) Kategorie: Cat6A Geschirmt: 1 Polanzahl: 2 P Schutzart: IP2X Höhe installiertes Produkt: 38 mm Breite installiertes Produkt: 50 mm Tiefe installiertes Produkt: 25 mm Typ des Zubehörs: Stecker Farbe: weiß Anschluss ohne Werkzeuge: 0 Geeignet für Massivleiter: 1 Fabrikat: Hager Art.-Nr.: ZZ45WAN2PP liefern, montieren und betriebsfertig anschließen.	**84 St**	EP 33,70	GP 2.830,80
02.11	**SLS-Schalter 3 polig E-Charakteristik 35A für Sammelschiene** KG: -			
	SLS-Schalter 3 polig E-Charakteristik 35A für Sammelschiene mit QuickConnect. SH-Schalter nach DIN VDE 0641-21 und Maßnorm DIN 43880 Baugröße 6. SLS in verschieden poliger Bauform, einpolig schaltend, mit separater Kontaktstellungsanzeige. Steckkontaktierung für direkte Sammelschienenmontage. Der serienmäßige Multifunktionsverschluß ermöglicht folgende Sperrungen: für den Kunden gegen unbeabsichtigtes oder mutwilliges Schalten, für den Installateur mit einem			

- Fortsetzung auf nächster Seite -

Übertrag: 87.451,98

Angebots-LV

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 87.451,98

Vorhängeschloss beim Arbeiten in der Anlage, für das VNB mit Plombierdraht, Vorhängeschloss oder Spezialschlüssel.

Auslösercharakteristik:	E
Nennstrom:	35 A
Polart:	3 P
Montageart:	für Sammelschienen
Einstellung des thermischen Auslösers in AC:	1.05 / 1.2 In
Bemessungsbetriebsspannung Ue:	230 / 400 V
Isolationsspannung:	690 V
Polanzahl:	3 P
Anzahl Module:	4.5
Anschlussquerschnitt bei flexiblem Leiter:	1 - 16mm²
Anschlussquerschnitt bei starrem Leiter:	1 - 25mm²
Höhe installiertes Produkt:	158 mm
Breite installiertes Produkt:	81 mm

Fabrikat: Hager
Art.-Nr.: HTS335E

liefern, montieren und betriebsfertig anschließen.

84 St EP 137,79 GP 11.574,36

02.12 **Kombiableiter Überspannungsschutz 4P limp 7,5kA TT/TNS** KG: -

Kombiableiter T1+T2+T3 4P limp 7,5kA TT/TNS

Zum Einsatz im Vorzählerbereich gemäß VDE-AR-N 4100.
Ableiter Typ 1 + Typ 2 nach DIN EN 61643-11.
Folgestromfreie, gekapselte Funkenstreckentechnologie.
Direkt auf 40 mm-Sammelschienensystem montierbar.
Kompatibel mit Einspeiseadapter und Sammelschienenbox zum Spannungsabgriff für RfZ und APZ.
Optionaler Fernmeldekontakt nachrüstbar.

Vorsicherung:	160 A
Netzform:	TT/TN-S
Anzahl Module:	1.5
Bemessungsspannung Uc laut IEC61643-1:	255 V
Schutzpegel Up:	1.5 kV
Bemessungsbetriebsspannung Ue:	230 / 400 V
Betriebstemperatur:	-40 80 °C
Prüfklasse IEC61643-11 / VDE0675-6-11:	T1+T2+T3

Fabrikat: Hager
Art.-Nr.: SPA701Z

liefern, montieren und betriebsfertig anschließen.

42 St EP 410,08 GP 17.223,36

Übertrag: 116.249,70

Angebots-LV

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 116.249,70

02.13 **Kabelrangierkanal, 3-feldig, aufsteckbar, 176 x 800 x 135mm** KG: -

Kabelrangierkanal, 3-feldig, aufsteckbar, 176 x 800 x 135mm

Elektro-Installationskanal-System Rangierkanal-Set RK aus Kunststoff, als Übergang zwischen verlegten Leitungen oder Installationskanälen und Verteilerschränke.
Rangierkanal Set bestehend aus Kanalprofil mit Sollbruchstellen zum Ausklinken für Installationskanäle für Tiefe 40, 50 und 60 mm.
Steckbare und verschiebbare Profilhaltern mit Putzausgleich, mit Rastnasen für Verteilerschränke IP44/55 mit Tiefe 150 und 205 mm. Zwei Profilhalter für Schränke bis Feldbreite 800 mm sowie drei Profilhaltern bis Feldbreite 1300 mm. Aufsteckbare Endkappen für links und rechts sind zu verschließen.

Höhe installiertes Produkt:	176 mm
Breite installiertes Produkt:	800 mm
Tiefe installiertes Produkt:	135 mm
Montageart:	QuickSet
Farbe: reinweiß RAL	9010
RAL Farbnummer:	9010
Werkstoff:	Kunststoff

Fabrikat: Hager
Art.-Nr.: FZ443N

liefern, montieren und betriebsfertig anschließen.

42 St EP 131,59 GP 5.526,78

02.14 **Aderleitung H07-U 1x10mm2 schwarz** KG: -

Aderleitung H07-U 1x10 mm2 schwarz, nach VDE 0285-525-2-31.

Bestimmt für die Verlegung in Rohren auf, in und unter Putz sowie in geschlossenen Installationskanälen.
Für die innere Verdrahtung von Geräten, Schaltanlagen und Verteilern sowie für geschützte Verlegung in und an Leuchten mit einer Nennspannung bis 1000 V Wechselspannung oder einer Gleichspannung bis 750 V gegen Erde.

Merkmal-Bezeichnung	Ausprägung
Leiter-Material	Kupfer
Leiter-Form	rund
Leiter-Klasse Kl.1	eindrähtig
Ader-Zahl	1
Werkstoff der Aderisolation	Polyvinylchlorid (PVC)
Zul. max. Leitertemperatur	70 °C
Schutzleiter	Nein

- Fortsetzung auf nächster Seite -

Übertrag: 121.776,48

Angebots-LV

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 121.776,48

Schirm Nein
Bewehrung/Armierung ohne
Mantelmaterial ohne
Mantel-Farbe ohne

Brandverhaltensklasse nach EN 13501-6 Eca
Halogenfrei nach EN 60754-1/2
Flammwidrig nach EN 60332-1-2
Raucharm nach EN 61034-2 Nein
Zul. Kabelaußentemperatur bei Montage/Handling 5 <=> 70 °C
Zul. Kabelaußentemperatur nach Montage ohne Erschütterung
-40 <=> 70 °C
Nennspannung U0 450 V
Nennspannung U 750 V
Biegeradius min. 4 x Außen-Ø
Zul. Kurzschlußtemperatur 160 °C

Fabrikat: LAPP Kabel

liefern, montieren und betriebsfertig anschließen.

210 m EP 5,29 GP 1.110,90

02.15 **Aderleitung H07-U 1x10mm2 blau** KG: -

Wie Position 02.14 (Seite 17) jedoch:
Aderleitung H07-U 1x10mm2 blau

63 m EP 5,03 GP 316,89

02.16 **Aderleitung H07-U 1x10mm2 gelb grün** KG: -

Wie Position 02.14 (Seite 17) jedoch:
Aderleitung H07-U 1x10mm2 gelb grün

63 m EP 5,59 GP 352,17

02.17 **Aderendhülse 10mm2** KG: -

Aderendhülse 10 mm2 nach DIN 46228 Teil 1

Für fein- und feinstdrähtige Leiter, z. B. nach DIN EN 60228 Kl. 5 und 6.
Spleißfreie Kabeleinführung durch aufgeweitete Hülse.
Aus Kupfer, galvanisch verzinnt zum Schutz gegen Korrosion.

- Fortsetzung auf nächster Seite -

Übertrag: 123.556,44

Angebots-LV

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	123.556,44
	Fabrikat: Klauke Art.-Nr.: 47612 liefern und montieren	**756 St**	EP 1,76	GP 1.330,56
02.18	**RJ45 Modul (E-Dat), universal, C6, ISO A, 10GBit Ethernet** RJ45 Modul (E-Dat), 10GBit Ethernet (IEEE 802.3an), 180° Universales Modul C6 nach ISO A . Geschirmtes E-DAT Modul (Buchse) nach Kategorie 6 A, geprüfte Ausführung für Datenübertragungsraten bis 10 GBit geeignet nach IEEE 802.3an. Metallgehäuse aus Zinkdruckguss, Zugentlastung mit Kabelbinder am Modul und Kabelzuführung 180°. Fabrikat: Hager Art.-Nr.: VZ314RJ liefern, montieren und betriebsfertig anschließen.	**84 St**	EP 42,99	GP 3.611,16
02.19	**Patch-Leitung mit 2xRJ45 Stecker für WAN-Anwendung,** Patch-Leitung mit 2xRJ45 Stecker für WAN-Anwendung, Farbe blau Länge 2 m Geschirmt: 1 Leitungslänge: 2 m Fabrikat: Hager Art.-Nr.: ZZ45WAN200 liefern, montieren und betriebsfertig anschließen.	**84 St**	EP 18,00	GP 1.512,00
02.20	**Bestückungspaket für Spanungsversorgung APZ/RfZ** Bestückungspaket für Spanungsversorgung APZ/RfZ SABO 1.6A im NAR Bauhöhe: 1400mm, Polanzahl: 2 P			

- Fortsetzung auf nächster Seite -

Übertrag: 130.010,16

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	130.010,16

Polart: 1P+N

Fabrikat: Hager
Art.-Nr.: ZY5N2SA

liefern, montieren und betriebsfertig anschließen.

42 St EP 70,99 GP 2.981,58

02.21 **FI-Schutzschalter Typ A, 4P,40A, 30mA** KG: -

FI-Schutzschalter Typ A, 4P,40A, 30mA, 3kA, 4TE

Fehlerstrom-Schutzschalter (RCCBs) zum Personen- und Sachschutz sowie zum Schutz vor elektrisch gezündeten Bränden gemäß DIN VDE 0100-410 und DIN VDE 0100-530.
Die Fehlerstrom-Schutzschalter gewährleisten Schutz bei sinusförmigen Wechselströmen und pulsierenden Strömen gegen Erde.
Er erfüllt die Produktnormen IEC/EN 61008-1, 61008-2-1, 61543 (VDE 0664 10, 11, 30) und für F200 A bis 100 A UL 1053.
Anschlussöffnung für Leitungen liegt oberhalb von der Anschlussöffnung für die Phasenschiene bis 63 A.
Zubehör wie Hilfs- und Signalschalter sind am Gerät ohne Zusatzverdrahtung anbaubar.

Normen:	EC/EN 61008, UL 1053
Fehlerstromart:	Typ A
Betriebskennlinie:	Unverzögert
Anzahl der Pole:	4
Bemessungsstrom:	40 A
Bemessungsfehlerstrom:	30 mA
Bemessungsspannung:	230/400 V
Bemessungsfrequenz:	50 / 60 Hz
Position des N-Leiters:	Rechts
Schutzart:	IP2X
Zubehör anbaubar:	Ja
Breite in Teilungseinheiten:	4

Fabrikat: ABB
Typ: F204 A-40/0,03
Art.-Nr.: CSF204101R1400

liefern, montieren und betriebsfertig anschließen.

42 St EP 109,90 GP 4.615,80

02.22 **Sicherungsautomat B-Char., 6 kA, 16 A, 1P** KG: -

Sicherungsautomat B-Char., 6 kA, 16 A, 1P

Sicherungsautomat zum Schutz vor Überlast und Kurzschluss von Kabel und Leitungen gemäß DIN VDE 0100-430 und DIN

- Fortsetzung auf nächster Seite -

Übertrag: 137.607,54

Angebots-LV

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 137.607,54

VDE 0100-530.
Erfüllt die Bauvorschriften DIN VDE 0641-11 bzw. IEC/EN 60898-1, DIN VDE 0660-101 bzw. IEC/EN60947-2 und UL1077.
Leiterquerschnitte bis zu 35 mm² können direkt an das Gerät angeschlossen werden.
Einfache und sichere Kontaktierung der Anschlussleitung mittels Druckplatte über die Anschlussklemme mit Isolierung in Schutzklasse IP20.
Anschlussöffnung für Leitungen liegt oberhalb von der Anschlussöffnung für die Phasenschiene. Hilfs- und Signalschalter sind am Gerät ohne Zusatzverdrahtung anbaubar.

Normen: IEC/EN 60898-1, IEC/EN 60947-2, UL 1077
Auslösecharakteristik: B
Anzahl der Pole: 1
Anzahl geschützter Pole: 1
Bemessungsstrom: 16 A
Bemessungs-Grenzkurzschlussausschaltvermögen:
(133 V AC) 20 kA, (230 V AC) 10 kA, (400 V AC) 10 kA
Bemessungsschaltvermögen:
230 / 400 V AC) 6 kA
Bemessungsbetriebsspannung:
(nach IEC 60898-1)230 / 400 V AC,(nach IEC 60947-2)230V
Anschlussart: Schraubklemmen
Zubehör anbaubar: Ja

Fabrikat: ABB
Typ: S201-B16
Art.-Nr.: 2CDS251001R1165

liefern, montieren und betriebsfertig anschließen.

252 St EP 12,30 GP 3.099,60

02.23 **Sicherungsautomat B-Char., 6 kA, 16 A, 3P** KG: -

Wie Position 02.22 (Seite 20) jedoch:
Sicherungsautomat B-Char., 6 kA, 16 A, 3P

Normen: IEC/EN 60898-1, IEC/EN 60947-2, UL 1077
Auslösecharakteristik: B
Anzahl der Pole: 3
Anzahl geschützter Pole: 3
Bemessungsstrom: 16 A
Bemessungs-Grenzkurzschlussausschaltvermögen:
(230 V AC) 20 kA, (400 V AC) 20 kA, (440 V AC) 10 kA
Bemessungsschaltvermögen:
(230 V AC) 6 kA, (400 V AC) 6 kA
Bemessungsbetriebsspannung:
(nach IEC 60898-1) 400 V AC, (nach IEC 60947-2) 440 V
Anschlussart: Schraubklemmen

- Fortsetzung auf nächster Seite -

Übertrag: 140.707,14

Angebots-LV

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 140.707,14

Zubehör anbaubar: Ja

Fabrikat: ABB
Typ: S203-B16
Art.-Nr.: 2CDS253001R0165

liefern, montieren und betriebsfertig anschließen.

42 St EP 32,25 GP 1.354,50

02.24 **Sicherungsautomat B-Char., 6 kA, 25 A, 3P** KG: -

Wie Position 02.22 (Seite 20) jedoch:
Sicherungsautomat B-Char., 6 kA, 25 A, 3P

Normen: IEC/EN 60898-1, IEC/EN 60947-2, UL 1077
Auslösecharakteristik: B
Anzahl der Pole: 3
Anzahl geschützter Pole: 3
Bemessungsstrom: 25 A
Bemessungs-Grenzkurzschlussausschaltvermögen:
(230 V AC) 20 kA, (400 V AC) 20 kA, (440 V AC) 10 kA
Bemessungsschaltvermögen:
(230 V AC) 6 kA, (400 V AC) 6 kA
Bemessungsbetriebsspannung:
(nach IEC 60898-1) 400 V AC, (nach IEC 60947-2) 440 V
Anschlussart: Schraubklemmen
Zubehör anbaubar: Ja

Fabrikat: ABB
Typ: S203-B25
Art.-Nr.: 2CDS253001R0255

liefern, montieren und betriebsfertig anschließen.

42 St EP 47,93 GP 2.013,06

02.25 **Phasenschiene 3 polig mit N-Ausslass** KG: -

Phasenschiene 3 polig mit N-Ausslass
Gabelanschluss 10mm² 63A 12 Module

Phasenschiene für passende Modulargeräte.
Nennstrom: 63 A
Polanzahl: 3 P
Länge: 210 mm

- Fortsetzung auf nächster Seite -

Übertrag: 144.074,70

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	144.074,70
	Anschlussquerschnitt bei starrem Leiter : 10mm² Fabrikat : Hager Art.-Nr.: KDN363F liefern, montieren und betriebsfertig anschließen.	**84 St**	EP 12,34	GP 1.036,56
02.26	**Phasenschiene 3 polig ohne N-Auslass** Phasenschiene 3 polig ohne N-Auslass Gabelanschluss 10mm² 63A 12 Module Phasenschiene für passende Modulargeräte. Nennstrom: 63 A Polanzahl: 3 P Länge: 210 mm Anschlussquerschnitt bei starrem Leiter : 10mm² Fabrikat : Hager Art.-Nr.: KDN363A liefern, montieren und betriebsfertig anschließen.	**126 St**	EP 9,27	GP 1.168,02
02.27	**Berührungsschutzabdeckung Phasenschiene** Berührungsschutzabdeckung Phasenschiene Passend zu angebotenen Phasenschienen. Schützen vor direkter Berührung der stromführenden Schiene. Für Sicherheit von Mensch und Tier. Fabrikat: Hager Art.-Nr.: KZ059 liefern und montieren.	**210 St**	EP 2,72	GP 571,20
02.28	**Lasttrennschalter 4-polig 63A** Lasttrennschalter 4-polig 63A m. schwarzem Knebelgriff Manuell betätigte Lasttrennschalter erfüllen die Gerätenorm DIN EN 60947-1 und DIN EN 60947-3. Sie sind für die Verwendung als Haupt-, Reparatur- und Netzumschalter geeignet. Zudem sind die Lasttrennschalter für den Front-, Verteiler- als auch für den Zwischeneinbau anwendbar. Montage der Schalter ist beliebig. Sie können über Kopf, horizontal, vertikal als auch um 180 Grad gedreht montiert werden. Die Pole können flexibel angeordnet werden und der			

- Fortsetzung auf nächster Seite -

Übertrag: 146.850,48

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 146.850,48

Einsatzbereich ist je nach Type für AC- und DC-Spannungen. Der Griff ist optional in der AUS-Stellung abschließbar. Des Weiteren kann der Schalter seitlich und von der Rückseite betätigt werden.

Normen: IEC 60947
Anzahl der Pole: 4
Bemessungskurzzeitstromfestigkeit: für 1,0 s 1 kA
Konventioneller thermischer Dauerstrom:
Vollständig gekapselt 80 A
Konventioneller thermischer Dauerstrom in freier Luft:
q=40°C 80 A
Bemessungsbetriebsstrom AC-21A:
(380 / 400 V) 80 A
Bemessungsbetriebsstrom AC-22A:
(380 . 415 V) 80 A, (500 V) 80 A, (690 V) 80 A
Bemessungsbetriebsstrom AC-23A:
(380 . 415 V) 75 A, (500 V) 58 A, (690 V) 20 A
Bemessungsbetriebsleistung AC-23A:
(220 . 240 V) 11 kW, (400 . 415 V) 22 kW, (500 V) 22 kW, (690 V) 15 kW
Bemessungsbetriebsspannung: Hauptstromkreis 750 V
Bemessungsstoßspannungsfestigkeit: 8 kV
Bemessungsisolationsspannung:
(nach IEC/EN 60664-1) 750 V
Schalter-Betriebsmechanismus:
Mechanismus auf der Oberseite des Schalters
Montageart: Bodenmontage
Verlustleistung: bei Bemessungsbedingungen pro Pol 2,8 W
Anschlussart: Schraubklemmen
Kabelquerschnitt: Cu 1,5.35 mm²
Schutzart: Front IP20

Fabrikat: ABB
Typ: OT63ML4
Art.-Nr.: 1SCA022530R6400

liefern, montieren und betriebsfertig anschließen.

42 St EP 147,85 GP 6.209,70

02.29 **FI-Schutzschalter Typ B, 4P, 40A, 30mA** KG: -

FI-Schutzschalter Typ B 4P, 40A, 30mA, 3kA, 4TE

Fehlerstrom-Schutzschalter (RCCBs) bieten Personen- und Sachschutz sowie einen Schutz vor elektrisch gezündeten Bränden gemäß DIN VDE 0100-410 und DIN VDE 0100-530. Die Fehlerstrom-Schutzschalter gewährleisten Schutz bei sinusförmigen Wechselströmen und pulsierenden Strömen gegen Erde sowie Fehlerströme mit glatten Gleichfehlerströmen und mit unterschiedlichsten (Hoch-/)Frequenzen im

- Fortsetzung auf nächster Seite -

Übertrag: 153.060,18

Angebots-LV

01 LV Elektroinstallation
02 Titel Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 153.060,18

Frequenzbereich von 0-2 kHz.
Sie erfüllen die Produktnormen für Typ A IEC/EN 61008-1, 61008-2-1, 61543 (VDE 0664 10, 11, 30) und Typ B DIN EN 62423 (VDE 0664-40).
Anschlussöffnung für Leitungen liegt oberhalb von der Anschlussöffnung für die Phasenschiene bis 63 A.
Zweipoliger Geräte in nur zwei Modulen.
Zubehör wie Hilfs-, Signalschalter und Unterspannungsauslöser für Not-Aus-Kreise sind am Gerät ohne Zusatzverdrahtung anbaubar.

Normen:	IEC/EN 61008
Fehlerstromart:	Typ B
Betriebskennlinie:	kurzzeitverzögert (AP-R)
Anzahl der Pole:	4
Bemessungsstrom:	40 A
Bemessungsfehlerstrom:	30 mA
Bemessungsspannung:	230/400 V
Bemessungsfrequenz:	50 / 60 Hz
Position des N-Leiters:	Rechts
Schutzart:	Gehäuse IPX4, Anschlussklemmen IP2X
Zubehör anbaubar:	Ja
Breite in Teilungseinheiten:	4

Fabrikat: ABB
Typ: F204 B-40/0.03
Art.-Nr.: 2CSF204568R1400

liefern, montieren und betriebsfertig anschließen.

42 St EP 470,65 GP 19.767,30

02.30 **Sicherungsautomat B-Char., 6 kA, 25 A, 3P** KG: -

Sicherungsautomat B-Char., 6 kA, 25 A, 3P

Sicherungsautomat zum Schutz vor Überlast und Kurzschluss von Kabel und Leitungen gemäß DIN VDE 0100-430 und DIN VDE 0100-530.
Erfüllt die Bauvorschriften DIN VDE 0641-11 bzw. IEC/EN 60898-1, DIN VDE 0660-101 bzw. IEC/EN60947-2 und UL1077.
Leiterquerschnitte bis zu 35 mm² können direkt an das Gerät angeschlossen werden.
Einfache und sichere Kontaktierung der Anschlussleitung mittels Druckplatte über die Anschlussklemme mit Isolierung in Schutzklasse IP20.
Anschlussöffnung für Leitungen liegt oberhalb von der Anschlussöffnung für die Phasenschiene.
Hilfs- und Signalschalter sind am Gerät ohne Zusatzverdrahtung anbaubar.

- Fortsetzung auf nächster Seite -

Übertrag: 172.827,48

Angebots-LV

01	LV	**Elektroinstallation**
02	Titel	Zählerschrank Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	172.827,48

Normen:
IEC/EN 60898-1, IEC/EN 60947-2, UL 1077
Auslösecharakteristik: B
Anzahl der Pole: 3
Anzahl geschützter Pole: 3
Bemessungsstrom: 25 A
Bemessungs-Grenzkurzschlussausschaltvermögen:
(230 V AC) 20 kA, (400 V AC) 20 kA, (440 V AC) 10 kA
Bemessungsschaltvermögen:
(230 V AC) 6 kA, (400 V AC) 6 kA
Bemessungsbetriebsspannung:
(nach IEC 60898-1) 400 V AC, (nach IEC 60947-2) 440 V
Anschlussart: Schraubklemmen
Zubehör anbaubar: Ja

Fabrikat: ABB
Typ: S203-B25
Art.-Nr.: 2CDS253001R0255

liefern, montieren und betriebsfertig anschließen.

42 St EP 47,93 GP 2.013,06

Summe Titel 02

Zählerschrank Wohnungen und Bestückung, Netto: 174.840,54 EUR

Leistungsverzeichnis

Leistung (Titel)

03

Unterverteiler Wohnungen und Bestückung

Angebots-LV

01 LV Elektroinstallation
03 Titel Unterverteiler Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Einbaugeräte

Die nachstehenden Einbaugeräte werden in die vorstehenden Verteilungen betriebsfertig eingebaut und einschließlich Verdrahtungs- und Kleinmaterial komplett geliefert und montiert.

03.1 **Kleinverteiler Unterputz 630,5x348x94,5 mm, 36 PLE**
Grundposition 005.0

Kleinverteiler Unterputz 630,5x348x94,5 mm, nach DIN VDE 60670-24 und DIN 43871.

Geeignet zum Einsatz in Wohngebäuden nach DIN 18015.
Zum Einbau von Geräten bis 63 A mit 70 mm Einbautiefe nach Maßnorm DIN 43880, Bemessungsspannung 400V/50Hz.
Schutzart IP30, Schutzklasse II schutzisoliert.
Bestehend aus: Kunststoff-Mauerkasten mit serienmäßigem Leitungsabfang und ausbrechbaren Leitungseinführungsschiebern mit Schnappbefestigung, integrierter Wasserwaage und verzinkten Stahlblech-Befestigungslaschen.
Geräteträger aus verzinktem Stahlblech, Hutschienen einzeln isoliert einbaubar.
Geräteabdeckung aus Kunststoff mit 46 mm Geräteschlitz, Schnellverschlussbefestigung mit 90° Drehung, serienmäßig plombierbar. Verdrehbarer Blendrahmen mit Tür aus Stahlblech, pulverbeschichtet und eingebrannt, mit 15 mm Putzausgleich.
Tür, frontbündig mit innenliegenden handbedienbaren Scharnieren. Türverschluss mit frontbündiger Griffmulde und selbsttätig zurückklappendem Griff, Türanschlag rechts oder links ohne Blendrahmendemontage. Serienmäßige Schaltplanbefestigung in der Tür und integrierter seitlicher Leitungsführungskanal mit Kabelhalteklammern. Fingersichere PE/N-Klemme mit Stecktechnik in montagefreundlicher Schnapptechnik und N-Klemme für FI-Kreise serienmäßig.

Montageart:	Unterputz
Anzahl Hutschienen:	3
Anzahl der Verteilerreihen:	3
Anzahl Module:	36
Anzahl der halben Platzeinheiten von 17,5 mm:	72
Höhe installiertes Produkt:	630.5 mm
Breite installiertes Produkt:	348 mm
Tiefe installiertes Produkt:	94.5 mm
Türschliessungstyp:	Schnappverschluß
Farbe:	reinweiß RAL 9010
Tür Werkstoff:	Metall
Schutzart:	IP30
Schutzklasse: Schutzklasse	II
IK Codierung der mechanischen Stoßfestigkeit:	IK07
Werkstoff:	Kunststoff
Halogenfrei:	1

- Fortsetzung auf nächster Seite -

Übertrag: 0,00

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
03 Titel Unterverteiler Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 0,00

Fabrikat: Hager
Typ: Kleinverteiler Volta
Art.-Nr.: VU36NC

liefern, montieren und betriebsfertig anschließen.

42 St EP 142,92 GP 6.002,64

03.2 **Kleinverteiler Unterputz 684x310x120 mm, 48 PLE**
Wahlposition 005.1

Kleinverteiler Unterputz 684x310x120 mm

Kleinverteiler, Leer Schrank,

Montageart:
Unterputz, Hohlwand mit Zubehör, für den Innenbereich, mit Blendrahmen und Tür, mit VDE-Prüfzeichen, geltende Normen: DIN EN 61439-1; VDE 0660-600-1, DIN EN 61439-3; VDE 0660-600-3, pulverbeschichtet, in RAL 9016, Gehäuse aus Stahlblech, Leitungseinführung oben über Nippelflansch beiliegend, unten über Flanschöffnung vorgeprägt, RAL 7035, Kabelabfangschiene integriert, Geräteträger herausnehmbar,

Normen:	DIN EN 61439-3
Baureihe:	TU
Schutzart:	IP31
Schutzklasse:	II (schutzisoliert)
Rastereinheiten (RE):	4
Platzeinheiten PLE:	48
Feldbreite:	1
Höhe des Produkts:	684 mm
Breite des Produkts:	310 mm
Tiefe des Produkts:	120 mm
Nischen Höhe:	700 mm
Nischen Breite:	325 mm
Nischen Tiefe:	120 mm
Bemessungsstrom:	125 A
Montageart:	Unterputzmontage

Fabrikat: ABB STRIEBEL & JOHN
Typ: TU41
Art.-Nr.: 2CPX067709R9999

liefern, montieren und betriebsfertig anschließen.

42 St EP 243,93 - Nur EP -

03.3 **FI-Schutzschalter Typ A, 4P, 40A, 30mA** KG: -

FI-Schutzschalter Typ A, 4P, 40A, 30mA, 3kA, 4TE

Fehlerstrom-Schutzschalter (RCCBs) zum Personen- und Sachschutz sowie zum Schutz vor elektrisch gezündeten

- Fortsetzung auf nächster Seite -

Übertrag: 6.002,64

Angebots-LV

01 LV Elektroinstallation
03 Titel Unterverteiler Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 6.002,64

Bränden gemäß DIN VDE 0100-410 und DIN VDE 0100-530.
Die Fehlerstrom-Schutzschalter gewährleisten Schutz bei sinusförmigen Wechselströmen und pulsierenden Strömen gegen Erde.
Er erfüllt die Produktnormen IEC/EN 61008-1, 61008-2-1, 61543 (VDE 0664 10, 11, 30) und für F200 A bis 100 A UL 1053.
Anschlussöffnung für Leitungen liegt oberhalb von der Anschlussöffnung für die Phasenschiene bis 63 A.
Zubehör wie Hilfs- und Signalschalter sind am Gerät ohne Zusatzverdrahtung anbaubar.

Normen:	EC/EN 61008, UL 1053
Fehlerstromart:	Typ A
Betriebskennlinie:	Unverzögert
Anzahl der Pole:	4
Bemessungsstrom:	40 A
Bemessungsfehlerstrom:	30 mA
Bemessungsspannung:	230/400 V
Bemessungsfrequenz:	50 / 60 Hz
Position des N-Leiters:	Rechts
Schutzart:	IP2X
Zubehör anbaubar:	Ja
Breite in Teilungseinheiten:	4

Fabrikat:	ABB
Typ:	F204 A-40/0,03
Art.-Nr.:	CSF204101R1400

liefern, montieren und betriebsfertig anschließen.

42 St EP 113,27 GP 4.757,34

03.4 **Sicherungsautomat B-Char., 6 kA, 16 A, 1P** KG: -

Sicherungsautomat B-Char., 6 kA, 16 A, 1P

Sicherungsautomat zum Schutz vor Überlast und Kurzschluss von Kabel und Leitungen gemäß DIN VDE 0100-430 und DIN VDE 0100-530.
Erfüllt die Bauvorschriften DIN VDE 0641-11 bzw. IEC/EN 60898-1, DIN VDE 0660-101 bzw. IEC/EN60947-2 und UL1077.
Leiterquerschnitte bis zu 35 mm² können direkt an das Gerät angeschlossen werden.
Einfache und sichere Kontaktierung der Anschlussleitung mittels Druckplatte über die Anschlussklemme mit Isolierung in Schutzklasse IP20.
Anschlussöffnung für Leitungen liegt oberhalb von der Anschlussöffnung für die Phasenschiene. Hilfs- und Signalschalter sind am Gerät ohne Zusatzverdrahtung anbaubar.

Normen:

- Fortsetzung auf nächster Seite -

Übertrag: 10.759,98

Übertrag: 10.759,98

IEC/EN 60898-1, IEC/EN 60947-2, UL 1077
Auslösecharakteristik: B
Anzahl der Pole: 1
Anzahl geschützter Pole: 1
Bemessungsstrom: 16 A
Bemessungs-Grenzkurzschlussausschaltvermögen:
(133 V AC) 20 kA, (230 V AC) 10 kA, (400 V AC) 10 kA
Bemessungsschaltvermögen:
230 / 400 V AC) 6 kA
Bemessungsbetriebsspannung:
(nach IEC 60898-1) 230/400 V AC,(nach IEC 60947-2) 230V
Anschlussart: Schraubklemmen
Zubehör anbaubar: Ja

Fabrikat: ABB
Typ: S201-B16
Art.-Nr.: 2CDS251001R1165

liefern, montieren und betriebsfertig anschließen.

462 St EP 12,51 GP 5.779,62

03.5 **Sicherungsautomat B-Char., 6 kA, 16 A, 3P** KG: -

Wie Position 03.4 (Seite 30) jedoch:
Sicherungsautomat B-Char., 6 kA, 16 A, 3P

Normen:
IEC/EN 60898-1, IEC/EN 60947-2, UL 1077
Auslösecharakteristik: B
Anzahl der Pole: 3
Anzahl geschützter Pole: 3
Bemessungsstrom: 16 A
Bemessungs-Grenzkurzschlussausschaltvermögen:
(230 V AC) 20 kA, (400 V AC) 20 kA, (440 V AC) 10 kA
Bemessungsschaltvermögen:
(230 V AC) 6 kA, (400 V AC) 6 kA
Bemessungsbetriebsspannung:
(nach IEC 60898-1) 400 V AC, (nach IEC 60947-2) 440 V
Anschlussart: Schraubklemmen
Zubehör anbaubar: Ja

Fabrikat: ABB
Typ: S203-B16
Art.-Nr.: 2CDS253001R0165

liefern, montieren und betriebsfertig anschließen.

42 St EP 33,89 GP 1.423,38

Übertrag: 17.962,98

Angebots-LV

01 LV Elektroinstallation
03 Titel Unterverteiler Wohnungen und Bestückung

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	17.962,98

03.6 **Klingeltrafo 230V 8VA, 12V, EIN/AUS Schalter** KG: -

Klingeltrafo 230V 8VA, 12V, EIN/AUS Schalter

Bedingt kurzschlussfeste Klingeltransformatoren zur Versorgung mit Kleinspannung (SELV) für kurzzeitige Belastung zur Montage auf DIN-Schiene.
Erfüllt Standards IEC/EN 61558-2-8. Mit VDE und EAC Zulassung. Mit Handschalter zur Abschaltung des Sekundärausgangs an der Gehäusefront.

Bemessungsbetriebsspannung:	230 V AC
Primärspannung:	230 V
Sekundärspannung:	12 V
Verlustleistung:	2,5 W
Bemessungsleistung:	8 V·A

Fabrikat:	ABB
Typ:	TS 8/12SW
Art.-Nr.:	2CSM081402R0811

liefern, montieren und betriebsfertig anschließen.

42 St EP 55,23 GP 2.319,66

Summe Titel 03

Unterverteiler Wohnungen und Bestückung, Netto: 20.282,64 EUR

Leistungsverzeichnis

Leistung (Titel)

04

Verlegesysteme

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
04 Titel Verlegesysteme

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Verlegesysteme

Die in den folgenden Positionen beschriebenen Kabeltragsysteme sind für die Installation der Gewerke Elektrotechnik und Schwachstromtechnik vorgesehen.
Alle Metallteile sind untereinander leitend zu verbinden und in den Potentialausgleich einzubeziehen.

Die Befestigungsabstände der nachfolgend beschriebenen Montagesysteme sind so gewählt, dass das Gewicht der Kabelrinne, die Belastung des Montagesystems, sowie das Gewicht der Leitungen entsprechend den Herstellerangaben ausgeführt wird. Ein Durchhängen der Kabelrinne ist nicht gestattet.

In den Einzelpreisen der Kabelrinne sind alle Klein-,Befestigungs-, Verbindungs- und Schutzmaterialien und Bügelschellen bei z.B. Steigleitern, sowie die oben genannten Forderungen einkalkuliert.

Zusätzlich gilt, dass für Befestigungssysteme im Funktionserhalt E30 und E90 alle Komponenten, wie z.B. Dübel, Gewindestange etc. einkalkuliert sind, damit das gesamte Kabeltragsystem eine bauaufsichtliche Zulassung erhält.

04.1 **Geräte-Verbindungsdose** KG: -

Geräte-Verbindungsdose 62 mm tief

Hohlwand Geräte-Verbindungsdose nach DIN VDE 0606-1 und DIN 49073 aus Kunststoff, mit PlusMinus-Geräteschrauben. Luftdicht und mit Klemmbefestigung.

Für Plattenstärke 7-40 mm,
Fräsloch- Ø 68 mm,
Kombi-Ausbrechöffnungen für NYM-Leitungen und Datenleitungen sowie für Rohre Ø 20/25 mm,
Schutzart IP 30

Fabrikat: Kaiser
Typ: O-range
Art.-Nr.: 9064-02

liefern, montieren und betriebsfertig anschließen.

1.680 St EP 17,88 GP 30.038,40

04.2 **Elektroinstallationsrohr DN20** KG: -

Elektroinstallationsrohr DN20 zur Verlegung in Hohlwänden

Nach DIN EN 61386-22, Maße nach DIN EN 60423.
Nicht flammenausbreitend,
aus Kunststoff mit Kunststoffmantel,

- Fortsetzung auf nächster Seite -

Übertrag: 30.038,40

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
04 Titel Verlegesysteme

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 30.038,40

halogenfrei nach DIN EN 50642,
rauchgasarm DIN EN 61034-2,
korrosiv nach DIN EN 60754-2,
mit hochgleitfähiger Innenschicht,
mit durchgehenden weißen Farbstreifen,
doppelwandig, innen gewellt, außen glatt, biegsam.

Außendurchmesser: 20 mm,
Klassifizierungscode: 33532,
Druckfestigkeit: mittel,
Schlagfestigkeit: mittel,
Dauergebrauchs- und Installationstemperatur
min.: - 45°C
max. +105°C,
Verlegung in Hohlwand.

Fabrikat: FRÄNKISCHE
Typ: FFKuS-EM-F-LS0H 20 Low Smoke 33532
Art.-Nr.: 25510020

liefern und montieren

9.450 m EP 14,37 GP 135.796,50

04.3 **Elektroinstallationsrohr DN30** KG: -

Elektroinstallationsrohr DN30 zur Verlegung in Hohlwänden

Nach DIN EN 61386-22, Maße nach DIN EN 60423.
Nicht flammenausbreitend,
aus Kunststoff mit Kunststoffmantel,
halogenfrei nach DIN EN 50642,
rauchgasarm DIN EN 61034-2,
korrosiv nach DIN EN 60754-2,
mit hochgleitfähiger Innenschicht,
mit durchgehenden weißen Farbstreifen,
doppelwandig, innen gewellt, außen glatt, biegsam.

Außendurchmesser: 32 mm,
Klassifizierungscode: 33532,
Druckfestigkeit: mittel,
Schlagfestigkeit: mittel,
Dauergebrauchs- und Installationstemperatur
min.: - 45°C
max. +105°C,
Verlegung in Hohlwand.

- Fortsetzung auf nächster Seite -

Übertrag: 165.834,90

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
04 Titel Verlegesysteme

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	165.834,90
	Fabrikat: FRÄNKISCHE Typ: FFKuS-EM-F-LS0H 32 Low Smoke 33532 Art.-Nr.: 25510032 liefern und montieren	630 m	EP 18,95	GP 11.938,50
04.4 Grundposition 006.0	**Kabelrinne 60 mm x 100 mm** Kabelrinne 60 mm x 100 mm nach DIN EN 61537 Mit Schnellverbindungs-System, inklusive aller bereits integrierten Verbindungsbauteile zur zeitsparenden und wirtschaftlichen Installation. Steckrichtung von oben für verbesserte Tragfähigkeit. Potentialausgleich nach DIN EN 61537 ohne Zusatzbauteile sowie ohne Verschraubung. Lochung 11 mm für die direkte Gewindestangenabhängung. Korrosionsschutz: bandverzinkt nach DIN EN 10346 Blechstärke: 0,75 mm Seitenhöhe: 60 mm Breite: 100 mm Länge: 1000 mm Tragfähigkeit: 0,9 kN/m bei Stützabstand 1,5m Fabrikat: OBO Bettermann Typ: RKSM 610 FS Art.-Nr.: 6047611 liefern und montieren	378 m	EP 61,05	GP 23.076,90
04.5 Wahlposition 006.1	**Kabelrinne 35 mm x 100 mm** Wie Position 04.4 jedoch: Kabelrinne 35x100 Zur Kabelführung bei geringer Platzverfügbarkeit. Korrosionsschutz: bandverzinkt nach DIN EN 10346 Blechstärke: 0,75 mm Seitenhöhe: 35 mm Breite: 100 mm Länge: 1000 mm			

- Fortsetzung auf nächster Seite -

Übertrag: 200.850,30

Übertrag: 200.850,30

Tragfähigkeit: 0,5 kN/m bei Stützabstand 1,5m

Fabrikat: OBO Bettermann
Typ: RKSM 310 FS
Art.-Nr.: 6047417

liefern und montieren

378 m EP 59,85 - Nur EP -

04.6 **Brandschutzschaum Kabelabschottung feuerbeständig** KG: -

HILTI CFS-F FX "200" Brandschutzschaum Kabelabschottung in Massivwand, -decke oder Leichter Trennwand.

Brandschutzabschottung von Kabeln, Kabelbündeln bis 110 mm Durchmesser, Elektro Leerrohre bis 32 mm (gebündelt bis 65 mm, Bündel aus 16 mm Leerrohren bis 100 mm) und Kabeltrassen aller Art. Schottstärke 200 mm.

Laibungserstellung in leichter Trennwand und Aufleisten der Wandstärke auf notwendige Schottstärke bauseits.
Feuerwiderstandsklasse feuerbeständig.
Nachbelegung uneingeschränkt gefordert.

Montagehinweis:
Es sind die jeweilig in der Zulassung geregelten Materialien und Mindestabstände zu beachten.

Max. Schottgröße Wand 600 x 600 mm bzw.0,36 m²,
Decke 400 x 400 mm bzw. 0,16 m².

Beschichtung der Kabel ist nicht erforderlich, max. Kabel- u. Rohrbelegung 60% der Öffnungsgröße.
Kombinationsmöglichkeit mit anderen Brandschutzprodukten (CFS-BL P).

Kennzeichnung mit einem Ausführungsschild.
Fachgerechter Einbau und Verwendung.
Auf eine rauchgasdichte Ausführung ist zu achten.
Allgemeine Bauaufsichtliche Zulassung Z-19.53-2237

Die Abrechnung erfolgt anhand der benötigten Schaumkartuschen.

Fabrikat: Hilti
Typ: CFS-F FX
Art.-Nr.: 29802

liefern und fachgerechte Ausführung des Öffnungsverschlusses.

210 St EP 95,05 GP 19.960,50

Übertrag: 220.810,80

Angebots-LV

HDU-Aufstockung (2204)

01	LV	Elektroinstallation
04	Titel	Verlegesysteme

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Summe Titel 04

Verlegesysteme, Netto: **220.810,80 EUR**

Leistungsverzeichnis

Leistung (Titel)

05

Kabel und Leitungen

Angebots-LV

01 LV Elektroinstallation
05 Titel Kabel und Leitungen

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Kabel und Leitungen

Die in den folgenden Positionen beschriebenen Starkstromkabel- und Leitungen sind gemäß ihren Bestimmungszweck und den DIN- Vorschriften geliefert und in Teillängen zu verlegen. Bei einem Spannungsfall der höher als in den Vorschriften angegeben ist, wird automatisch der nächst größere Leitungsquerschnitt verlegt, auch wenn dieser nicht ausgeschrieben ist. Die vorgegebenen Biegeradien der Kabel und Leitungen werden eingehalten.

Die Leitungen gelten für folgende Bereiche:
- Energieversorgung
- Elektroinstallation Innen und Außen
- Klima-, Lüftung- und Heizungsanlage

Leitungen in bauseits vorhandenen Schlitzen und Bohrungen, separat ausgeschriebene Leerrohre, Kabelbühnen oder Kanäle einziehen, bzw. innerhalb der abgehängten Decke mit Sammelhalterungen oder bei Häufung auf Kabelbühnen verlegen.

Erdleitungen werden in bauseitigen Kabelgräben mit Warnband verlegt.

Bei Anschluss von Aluminiumkabeln (z.B. an Kupferschienen) werden ausschließlich dafür zugelasse Kabelschuhe verwendet.

Bei der Verlegung auf Kabeltragesystemen werden die Kabel und Leitungen durchgängig geordnet und gebündelt verlegt. Hierfür benötigtes Kleinmaterial wie Kabelbinder und Befestigungsschellen sind einkalkuliert.

05.1 **Installationsleitung NYM-J 3 x 2,5 mm2** KG: -

Installationsleitung NYM-J 3 x 2,5 mm2

Für Putz, Mauerwerk und unbewegten Beton;

Nennspannung U0/U: 300/500V;
Prüfspannung: 2000V;

Aderisolation auf PVC-Basis;
Ader-Ident-Code: bis 5 Adern nach VDE 0293-308, ab 6 Adern schwarz mit weißen Ziffern.

Leiter: Kupferlitze blank
eindrähtig: 1,5 mm² - 10 mm²,
mehrdrähtig: 16 mm² - 35 mm²;

Füllmischung über dem Aderverband;
Außenmantel auf PVC-Basis;

- Fortsetzung auf nächster Seite -

Übertrag: 0,00

Angebots-LV

01 LV Elektroinstallation
05 Titel Kabel und Leitungen

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	0,00
	Temperaturbereich: bei Verlegung: +5°C bis 60°C, fest verlegt: -40°C bis +70°C; flammwidrig nach IEC 60332-1-2; Norm-Referenzen: VDE 0250 Teil 204; Fabrikat: LAPP Kabel Art.-Nr.: 16000213 liefern, montieren und betriebsfertig anschließen.	**9.450 m**	EP 6,55	GP 61.897,50
05.2	**Installationsleitung NYM-J 5 x 2,5 mm2** KG: -			
	Wie Position 05.1 (Seite 40) jedoch: Installationsleitung NYM-J 5 x 2,5 mm2 Fabrikat: LAPP Kabel Art.-Nr.: 16000063 liefern, montieren und betriebsfertig anschließen.	**840 m**	EP 9,09	GP 7.635,60
05.3	**Installationsleitung NYM-J 5 x 10 mm2** KG: -			
	Wie Position 05.1 (Seite 40) jedoch: Installationsleitung NYM-J 5 x 10 mm2 Fabrikat: LAPP Kabel Art.-Nr.: 16000533 liefern, montieren und betriebsfertig anschließen.	**630 m**	EP 25,42	GP 16.014,60
05.4	**Aderleitung H07V-K N/H 1 X 2,5 mm2 GNYE** KG: -			
	Aderleitung H07V-K N/H 1 X 2,5 mm2 GNYE Einzelader für vielseitige Anwendungen mit <VDE>-Bauartzertifizierung; Nennspannung U0/U: 450/750V; Prüfspannung: 2500V; Aderisolation auf PVC-Basis; Leiter: Kupferlitze blank, feindrähtig nach VDE 0295, Klasse 5; Temperaturbereich: Bewegt: +5°C bis +70°C, fest verlegt: -30°C bis +80°C; Flammwidrig nach IEC 60332-1-2; Norm-Referenzen: in Anlehnung an EN 50525-2-31;			

- Fortsetzung auf nächster Seite -

Übertrag: 85.547,70

Angebots-LV

01 LV Elektroinstallation
05 Titel Kabel und Leitungen

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	85.547,70
	Fabrikat: LAPP Kabel Art.-Nr.: 8120002 liefern, montieren und betriebsfertig anschließen.	**1.260 m**	EP 5,48	GP 6.904,80
05.5	**Aderleitung H07V-K N/H 1 X 2,5 mm2 BU** KG: - Wie Position 05.4 (Seite 41) jedoch: Aderleitung H07V-K N/H 1 X 2,5 mm2 BU Fabrikat: LAPP Kabel Art.-Nr.: 8120022 liefern, montieren und betriebsfertig anschließen.	**1.260 m**	EP 4,22	GP 5.317,20
05.6	**Aderleitung H07V-K N/H 1 X 2,5 mm2 BN** KG: - Wie Position 05.4 (Seite 41) jedoch: Aderleitung H07V-K N/H 1 X 2,5 mm2 BN Fabrikat: LAPP Kabel Art.-Nr.: 8120032 liefern, montieren und betriebsfertig anschließen.	**1.260 m**	EP 3,34	GP 4.208,40
05.7	**Netzwerkleitung Datenleitung Cat.7 Simplex 1000 MHz orange** KG: - Netzwerkleitung Datenleitung Cat.7 Simplex 1000 MHz orange Ethernet Installationskabel für die feste Verlegung Kategorie: Cat.7 mit 1.000 MHz und S/FTP (PIMF) Abschirmung Leiteraufbau: Twisted Pair 4 Adernpaare AWG23/1 (Ø 0,57 mm) Kupfer Innenleiter: Kupferdraht, starr Außendurchmesser: 7,3 mm Farbe: orange			

- Fortsetzung auf nächster Seite -

Übertrag: 101.978,10

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
05 Titel Kabel und Leitungen

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	101.978,10
	Meterskalierung aufgedruckt Fabrikat: LAPP Kabel Art.-Nr.: 2170614 liefern, montieren und betriebsfertig anschließen.	**2.100 m**	EP 6,42	GP 13.482,00
Summe Titel 05		**Kabel und Leitungen, Netto:**		**115.460,10 EUR**

Leistungsverzeichnis

Leistung (Titel)

06

Elektro-Klemmen

Angebots-LV

01 LV Elektroinstallation
06 Titel Elektro-Klemmen

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Elektro-Klemmen

Notwendiges Kleinmaterial ist in den Positionspreisen einkalkuliert.
Installation in bauseits vorhandenen Schlitzen, Bohrungen und Wandöffnungen.

06.1 **Verbindungsdosenklemmen 2,5 mm² 3-Leiter-Klemme** KG: -

Verbindungsdosenklemmen 2,5 mm² 3-Leiter-Klemme

COMPACT-Verbindungsdosenklemmen 2,5 mm² 3-Leiter-Klemme.

Bemessungsspannung (III / 2):	450 V
Bemessungsstoßspannung (III / 2):	4 kV
Bemessungsstrom:	24 A
Dauergebrauchstemperatur:	105 °C
Umgebungstemperatur max.:	60 °C (T60)
Hinweis: in geerdeten Netzen	

Anschlussdaten	
Eindrähtiger Leiter:	0,5 - 2,5 mm² / 18 - 14 AWG
Anschlusstechnik:	PUSH WIRE
Abmessungen (B x H x T):	14 x 5,8 x 16,7 mm
Gehäusefarbe:	transparent
Deckelfarbe:	orange

Fabrikat:	WAGO
Typ:	COMPACT
Art.-Nr.:	2273-203

liefern, montieren und betriebsfertig anschließen.

168 St EP 0,11 GP 18,48

06.2 **Verbindungsdosenklemmen 2,5 mm² 5-Leiter-Klemme** KG: -

Wie Position 06.1 jedoch:
Verbindungsdosenklemmen 2,5 mm² 5-Leiter-Klemme

COMPACT-Verbindungsdosenklemmen 2,5 mm² 5-Leiter-Klemme

Abmessungen (B x H x T):	22 x 5,8 x 16,7 mm

Fabrikat:	WAGO
Typ:	COMPACT
Art.-Nr.:	2273-205

liefern, montieren und betriebsfertig anschließen.

168 St EP 0,17 GP 28,56

Übertrag: 47,04

Angebots-LV

01 LV Elektroinstallation
06 Titel Elektro-Klemmen

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 47,04

06.3 **MIDI Buchse, 3-polig, Schnellmontage, Zugentlastungsgehäuse** KG: -

MIDI Buchse, 3-polig, Schnellmontage, Zugentlastungsgehäuse

Zur schnellen Steckverbindung der installierten Module.

Anschlusstechnik Push-in CAGE CLAMP®
2x 0,5 mm²- 4 mm²/ 2x AWG 20-12
0,5 - 4 mm² "e + f"
0,5 - 2,5 mm² "mehrdrähtig"
für 1 Leitungen,

Durchmesser	7 - 11,5 mm
Bemessungsstoßspannung:	4 kV
Verschmutzungsgrad:	3
Spannung / Strom:	250 V/ 25 A
Farbe:	schwarz
Kodierung:	A

Fabrikat:	WAGO
Typ:	WINSTA
Art.-Nr.:	770-203/035-000

liefern, montieren und betriebsfertig anschließen.

336 St EP 11,59 GP 3.894,24

06.4 **MIDI Buchse, 5-polig, Schnellmontage, Zugentlastungsgehäuse** KG: -

MIDI Buchse, 5-polig, Schnellmontage, Zugentlastungsgehäuse

Zur schnellen Steckverbindung der installierten Module.

Anschlusstechnik Push-in CAGE CLAMP®
2x 0,5 mm²- 4 mm²/ 2x AWG 20-12
0,5 - 4 mm² "e + f"
0,5 - 2,5 mm² "mehrdrähtig"
für 2 Leitungen,

Durchmesser	9 - 13 mm
Bemessungsstoßspannung:	6 kV
Verschmutzungsgrad:	3
Spannung / Strom:	400 V/ 25 A
Farbe:	schwarz
Kodierung:	A

Fabrikat:	WAGO
Typ:	WINSTA
Art.-Nr.:	770-105

liefern, montieren und betriebsfertig anschließen.

252 St EP 14,33 GP 3.611,16

Übertrag: 7.552,44

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
06 Titel Elektro-Klemmen

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	7.552,44

06.5 **Geräteschrauben 3,2 25mm** KG: -

Geräteschrauben 3,2 25mm

Senkkopfschrauben zur Geräte-Befestigung von z.B. Schalter-Einsätzen und Steckdosen in Unterputzdosen bzw. Hohlwanddosen. Auch für Deckelbefestigung.

Die Schrauben sind korrosionsbeständig nach DIN VDE, selbstschneidend, doppelte Oberflächenveredelung,
Durchmesser: Ø 3,2 mm

3.024 St EP 0,14 GP 423,36

06.6 **2-Leiter-Leuchtenklemme** KG: -

2-Leiter-Leuchtenklemme, 2,5 mm²

Standardausführung
Bemessungsspannung (III / 2): 400 V
Bemessungsstoßspannung (III / 2): 4 kV
Bemessungsstrom: 24 A
Dauergebrauchstemperatur: 105 °C
Umgebungstemperatur max.: 60 °C (T60)
Hinweis: in geerdeten Netzen

Anschlussdaten
Anschlussobjekt: Installationsseite
Anschlusstechnik: PUSH WIRE
Eindrähtiger Leiter: 1 2,5 mm² / 14 12 AWG

Anschlussdaten 2
Anschlussobjekt 2: Leuchtenseite
Anschlusstechnik 2: CAGE CLAMP
Eindrähtiger Leiter 2: 0,5 2,5 mm² / 20 16 AWG
Feindrähtiger Leiter 2: 0,5 2,5 mm² / 20 16 AWG

Abmessungen (B x H x T): 9,5 x 15,5 x 20,4 mm
Farbe: weiß

Fabrikat: WAGO
Art.-Nr.: 224-112

liefern, montieren und betriebsfertig anschließen.

756 St EP 1,88 GP 1.421,28

Summe Titel 06

Elektro-Klemmen, Netto: 9.397,08 EUR

Leistungsverzeichnis

Leistung (Titel)

07

Installationsgeräte

Angebots-LV

01 LV Elektroinstallation
07 Titel Installationsgeräte

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Installationsgeräte Unterputz

Die nachfolgenden Installationsgeräte wie z.B. Schalter, Steckdosen, Abzweigdosen werden ohne Beschriftungsfeld geliefert.
Die Anordnung der Installationsgeräte wird gemäß den gültigen Normen und den Planungsvorgaben ausgeführt.
Die Schutzart der Installationsgeräte ist der Umgebung angepasst.

Die Aufputz-Installationsgeräte werden einschließlich aller Nebenarbeiten und allem Klein- und nichtrostenden Befestigungsmaterial geliefert.

Installation in bauseits vorhandenen Schlitzen, Bohrungen und Wandöffnungen.

Bei der Montage von Schalterdosen in Wänden mit besonderen Anforderungen (z.B. Schallschutzanforderungen bei Besprechungsräumen; Brandschutzanforderungen bei feuerbeständigen Wänden; Anforderungen an Luftdichtigkeit bei Räumen mit erhöhten Hygieneanforderungen usw.) sind ausschließlich für diesen Anwendungszweck bestimmte Schalterdosen verwendet.

07.1 **SCHUKO Steckdosen-Einsatz, alpinweiß**
Grundposition 007.0

SCHUKO Steckdosen-Einsatz

Mit Steckanschluss, Unterputz.
Zum Anschließen von elektrischen Verbrauchern.

Eingänge:	Steckklemmen, 0,6 mm² - 2,5 mm²
Nennstrom:	16 A
Schutzart Gerät:	IP 20
Farbe/Bezeichnung:	alpinweiß

Fabrikat:	Busch-Jaeger Elektro GmbH
Typ:	Busch-Balance SI
Art.-Nr.:	20 EUC-914

liefern, montieren und betriebsfertig anschließen.

1.512 St EP 18,70 GP 28.274,40

Übertrag: 28.274,40

Angebots-LV

01 LV Elektroinstallation
07 Titel Installationsgeräte

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	28.274,40

07.2 **SCHUKO Steckdosen-Einsatz, erhöhter Berührungsschutz, alpinweiß**
Wahlposition 007.1

Wie Position 07.1 (Seite 49) jedoch:
SCHUKO Steckdosen-Einsatz, erhöhter Berührungsschutz
alpinweiß

Hersteller: Busch-Jaeger Elektro GmbH
Art.-Nr.: Artikelnummer: 20 EUCRB-84

liefern, montieren und betriebsfertig anschließen.

1.512 St EP 25,17 - Nur EP -

07.3 **Herdanschlussdose für UP und AP, Unterputz** KG: -

Herdanschlussdose für UP und AP, Unterputz

Nennquerschnitt 2,5 mm²
mit bruchgeschütztem Deckel und Schnellverschluss,
Schraub- und Krallenbefestigung für 60er und 70er UP-Dosen,
abnehmbare Spreize,
Zugentlastung für Kabel bis 5 x 2,5 mm²

Schutzart Gerät: IP 20
Farbe/Bezeichnung: alpinweiß

Hersteller: Busch-Jaeger Elektro GmbH
Artikelnummer: 3746 U-101

liefern, montieren und betriebsfertig anschließen.

42 St EP 25,66 GP 1.077,72

07.4 **WLAN-Accesspoint, UP. 2,4 GHz**
Grundposition 006.0

WLAN-Accesspoint, UP

Spannungsversorgung durch Netzspannung, Unterputz.
Zur Montage in handelsüblichen tiefen UP- und Hohlwanddosen.
Betrieb als WLAN Access Point zum Anschluss von
WLAN-Endgeräten an das LAN.
Betrieb als WLAN Repeater zur Reichweitenverlängerung eines
WLAN.
Betrieb als WLAN Adapter zur Einbindung von
Ethernet-Endgeräten in ein WLAN.
Unterstützt WLAN Standards IEEE 802.11b/g/n mit 2,4 GHz,
integrierte WLAN-Antenne.
Sicherheit durch WEP, WPA und WPA2 Verschlüsselung.
Rückwärtiger Anschluss eines Ethernet-Kabels über
Schraubklemmen (10/100 Mbit/s).

- Fortsetzung auf nächster Seite -

Übertrag: 29.352,12

Angebots-LV

01 LV Elektroinstallation
07 Titel Installationsgeräte

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 29.352,12

Vorderseitige Ethernet-Anbindung über eine RJ45-Buchse (10/100 Mbit/s).
Die drei Anschlüsse (WLAN, Ethernet/Schraubklemmen und Ethernet/RJ45) können über den integrierten Switch parallel genutzt werden.

Stromversorgung. über 2-polige Anschlussklemme.
Nennspannung: 100 - 240 V~
Passend zur Zentralscheibe einer 1-fach UAE-Dose.

Maße (H x B x T): 80 mm
Nennfrequenz: 50 Hz - 60 Hz
Schutzart Gerät: IP 20

Fabrikat: Busch-Jaeger Elektro GmbH
Art.-Nr.: 8186/31-101

liefern, montieren und betriebsfertig anschließen.

84 St EP 197,24 GP 16.568,16

07.5 Wahlposition 008.1 **WLAN-Accesspoint, UP, 5 GHz**

WLAN-Accesspoint, UP, 5 GHz
mit RJ45-Frontport, reinweiß (ähnlich RAL 9010)

Ausgestattet mit:
- frontseitige RJ45-Stecköffnung für ein Datenendgerät
- Montage In handelsüblichen Up-Doppel-Geräteverbindungsdosen
- Nennbetriebsspannung: 100-240 V~/50-60 Hz
- Leistungsaufnahme: 5,5 VA typisch
- Temperaturbereich: -5°C - 35° C
- Funktionsanzeige über beleuchtete RJ45-Stecköffnung
- Anschluss Spannungsversorgung über rückseitige Steckklemmen (2,5mm²)
- Anschluss Datenkabel über frontseitige Schraub-/Steckklemme
- Übertragungsrate Datenkabel: 1000 Mbit/s
- Übertragungsrate RJ45: 100 Mbit/s
- Funkstandards: IEEE 802.11 a/b/g/n/ac (Wave 2)
- Frequenz/Datenrate: 2,4 GHz / 5 GHz, 300 Mbit/s / 876 Mbit/s (Dualmode)
- Sicherheit und Verschlüsselung: WPA, WPA2, MAC-Filterung
- mit Timer- und Zeitschaltfunktion
- Gast-WLAN zuschaltbar
- zentale Managementfunktion
- Reset über Reset-Magneten
- Mesh-Funktionalität

Passend zu entsprechenden Designabdeckungen der

- Fortsetzung auf nächster Seite -

Übertrag: 45.920,28

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 45.920,28

Schalterindustrie (Berker, Busch-Jaeger, GIRA, Jung, Merten u.a.)

Fabrikat: RUTENBECK
Art.-Nr.: 226104031

liefern, montieren und betriebsfertig anschließen.

84 St EP 283,93 - Nur EP -

07.6 **UAE-Anschlussdose, RJ45, 1 Steckbuchse**

Grundposition 009.0

UAE-Anschlussdose, RJ45; Cat. 6a iso, geschirmt, 1 Steckbuchse, 8 (8)-polig, Unterputz.

Für den Anschluss von datentechnischen Geräten.
Mit Schrägauslass und LSA-Schneidklemmen.
RJ-45-Anschlüsse für Netzwerke nach Cat. 6A, Class EA (10 Gbit/s / 500 MHz).
Entspricht Cat. 6A, Class EA gem. ISO/IEC 11801:2011-06.
Anschlusskennzeichnung A und B gemäß TIA/EIA-568-B.2.
Bauart nach EN 60 603-7-51:2011-01.
Abschirmung nach DIN EN 55022, Klasse B.
Bis 500 MHz auf allen Aderpaaren.
Geeignet für 10-Gigabit Ethernet.
Geeignet für PoE+ gemäß IEEE 802.3at, ? 1000 Steckkzyklen.
Flexible Kabelzuführung ohne Knicke von allen Seiten.
Gehäuse-Erdung mittels 6,3 mm-Flachsteckverbinder rückseitig möglich.

Re-embedded getestet.
Geeignet für Mix-and-Match-Einsatz.
Geeignet für RJ 11, RJ 12 und RJ 45 Stecker.
Für Datenkabel mit einem Durchmesser von 6-10 mm.
Für Adern von AWG 24-22.
Für Montage in Kabelkanälen, UP-Gerätedosen und Unterflursystemen. Ohne Spreize.

Einbautiefe 31 mm.
Schutzart Gerät: IP 20

Fabrikat: Busch-Jaeger Elektro GmbH
Art.-Nr.: 0218/11-101

liefern, montieren und betriebsfertig anschließen.

84 St EP 35,57 GP 2.987,88

Übertrag: 48.908,16

Angebots-LV

01 LV Elektroinstallation
07 Titel Installationsgeräte

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	48.908,16
07.7 Wahlposition 009.1	**UAE-Anschlussdose, RJ45, 2 Steckbuchsen** Wie Position 07.6 (Seite 52) jedoch: UAE-Anschlussdose, RJ45, 2 Steckbuchsen Fabrikat Busch-Jaeger Elektro GmbH Art.-Nr.: 0218/12-101 liefern, montieren und betriebsfertig anschließen.	**84 St**	EP 38,34	- Nur EP -
07.8 Grundposition 010.0	**Abdeckrahmen, 1-fach Rahmen, Unterputz** Abdeckrahmen, 1-fach Rahmen, Unterputz Zum Abdecken von Schaltern, Tastern und Steckdosen. Maße (H x B x T): 81 mm x 81 mm x 12 mm Schutzart Gerät: IP 20 Farbe/Bezeichnung: alpinweiß Fabrikat: Busch-Jaeger Elektro GmbH Typ: Busch-Balance SI Art.-Nr.: 1721-914 liefern, montieren und betriebsfertig anschließen.	**546 m**	EP 2,68	GP 1.463,28
07.9 Wahlposition 010.1	**Abdeckrahmen, 1-fach Rahmen, Unterputz, Weißglas** Abdeckrahmen, 1-fach Rahmen, Unterputz, Weißglas Zum Abdecken von Schaltern, Tastern und Steckdosen. Für senkrechte oder waagerechte Montage. Maße (H x B x T): 107 mm x 107 mm x 11 mm Schutzart Gerät: IP 20 Farbe/Bezeichnung: Weißglas Fabrikat: Busch-Jaeger Elektro GmbH Art.-Nr.: 1721-811 liefern, montieren und betriebsfertig anschließen.	**546 St**	EP 29,50	- Nur EP -
			Übertrag:	50.371,44

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 50.371,44

07.10 Grundposition 011.0

Abdeckrahmen, 2-fach Rahmen, Unterputz

Abdeckrahmen, 2-fach Rahmen, Unterputz

Zum Abdecken von Schaltern, Tastern und Steckdosen.

Maße (H x B x T): 152 mm x 81 mm x 12 mm
Schutzart Gerät: IP 20
Farbe/Bezeichnung: alpinweiß

Fabrikat: Busch-Jaeger Elektro GmbH
Typ: Busch-Balance SI
Art.-Nr.: 1722-914

liefern, montieren und betriebsfertig anschließen.

294 St EP 4,59 GP 1.349,46

07.11 Wahlposition 011.1

Abdeckrahmen, 2-fach Rahmen, Unterputz, Weißglas

Abdeckrahmen, 2-fach Rahmen, Unterputz, Weißglas

Zum Abdecken von Schaltern, Tastern und Steckdosen.
Für senkrechte oder waagerechte Montage.

Maße (H x B x T): 178 mm x 107 mm x 11 mm
Schutzart Gerät: IP 20
Farbe/Bezeichnung: Weißglas

Fabrikat: Busch-Jaeger Elektro GmbH
Art.-Nr.: 1722-811

liefern, montieren und betriebsfertig anschließen.

294 St EP 52,28 - Nur EP -

07.12 Grundposition 012.0

Abdeckrahmen, 3-fach Rahmen, Unterputz

Abdeckrahmen, 3-fach Rahmen, Unterputz

Zum Abdecken von Schaltern, Tastern und Steckdosen.

Maße (H x B x T): 223 mm x 81 mm x 12 mm
Schutzart Gerät: IP 20
Farbe/Bezeichnung: alpinweiß

Fabrikat: Busch-Jaeger Elektro GmbH
Typ: Busch-Balance SI
Art.-Nr.: 1723-914

liefern, montieren und betriebsfertig anschließen.

168 St EP 7,84 GP 1.317,12

Übertrag: 53.038,02

Angebots-LV

01 LV Elektroinstallation
07 Titel Installationsgeräte

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	53.038,02

07.13 **Abdeckrahmen, 3-fach Rahmen, Unterputz, Weißglas**
Wahlposition 012.1

Abdeckrahmen, 3-fach Rahmen, Unterputz, Weißglas

Zum Abdecken von Schaltern, Tastern und Steckdosen.
Für senkrechte oder waagerechte Montage.

Maße (H x B x T): 249 mm x 107 mm x 11 mm

Schutzart Gerät: IP 20
Farbe/Bezeichnung: Weißglas

Fabrikat: Busch-Jaeger Elektro GmbH
Art.-Nr.: 1723-811

liefern, montieren und betriebsfertig anschließen.

168 St EP 88,86 - Nur EP -

Summe Titel 07

Installationsgeräte, Netto: 53.038,02 EUR

Leistungsverzeichnis

Leistung (Titel)

08

Aufputz Betriebsmittel

Angebots-LV

01 LV Elektroinstallation
08 Titel Aufputz Betriebsmittel

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Installationsgeräte Aufputz

Die nachfolgenden Installationsgeräte wie z.B. Schalter, Steckdosen, Abzweigdosen werden ohne Beschriftungsfeld geliefert.
Die Anordnung der Installationsgeräte wird gemäß den gültigen Normen und den Planungsvorgaben ausgeführt.
Die Schutzart der Installationsgeräte ist der Umgebung angepasst.

Die Aufputz-Installationsgeräte werden einschließlich aller Nebenarbeiten und allem Klein- und nichtrostenden Befestigungsmaterial geliefert.

Installation in bauseits vorhandenen Schlitzen, Bohrungen und Wandöffnungen.

Bei der Montage von Schalterdosen in Wänden mit besonderen Anforderungen (z.B. Schallschutzanforderungen bei Besprechungsräumen, Brandschutzanforderungen bei feuerbeständigen Wänden, Anforderungen an Luftdichtigkeit bei Räumen mit erhöhten Hygieneanforderungen usw.) sind ausschließlich für diesen Anwendungszweck bestimmte Schalterdosen verwendet.

08.1 Grundposition 013.0 **Wippschalter, Aus- und Wechselschaltung, Aufputz, Grau/Blaugrün**

Wippschalter, Aus- und Wechselschaltung, Aufputz

Zum Schalten von elektrischen Verbrauchern.

Maße (H x B x T):	83 mm x 74 mm x 55 mm
Nennstrom:	10 AX
Lastart:	LEDi / CFLi
Nennleistung:	100 W
Schutzart Gerät:	IP 44
Farbe/Bezeichnung:	grau/blaugrün

Fabrikat:	Busch-Jaeger Elektro GmbH
Typ:	OCEAN
Art.-Nr.:	2601/6 W-53

liefern, montieren und betriebsfertig anschließen.

84 St EP 20,31 GP 1.706,04

08.2 Wahlposition 013.1 **Wippschalter, Aus- und Wechselschaltung, Aufputz Symbol Licht, Alpinweiß**

Wippschalter, Aus- und Wechselschaltung, Aufputz Symbol Licht, AS 500 Aufputz, alpinweiß

Mit Federklemmen für starre Leiter bis 2,5 mm²
Für Unterputzmontage mit Schraubbefestigung und Krallen

- Fortsetzung auf nächster Seite -

Übertrag: 1.706,04

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	1.706,04

mit Wippe, Duroplast.
L x B: 55 x 55 mm
und Aufputz-Kappe, Duroplast,
L x B: 85 x 85 x 47 mm
senkrechte und waagerechte Montage

Wippschalter, Universal Aus-Wechsel, 10 A 250 V~
Schutzwart: IP20
Farbe: Alpinweiß

Fabrikat: JUNG
Art.-Nr.: 506U, AS581AWW, A590LWW

liefern, montieren und betriebsfertig anschließen.

84 St EP 13,19 - Nur EP -

08.3 **SCHUKO Steckdose, 1-fach, Aufputz, Grau/Blaugrün**

Grundposition 014.0

SCHUKO Steckdose, 1-fach, Aufputz

Zum Anschließen von elektrischen Verbrauchern.
2 P + E, mit Steckanschluss, mit Klappdeckel,

Maße (H x B x T): 83 mm x 74 mm x 55 mm
Nennstrom: 16 A
Schutzart Gerät: IP 44
Farbe/Bezeichnung: grau/blaugrün

Fabrikat Busch-Jaeger Elektro GmbH
Typ: OCEAN
Art.-Nr.: 20 MW-53-500

liefern, montieren und betriebsfertig anschließen.

84 St EP 36,33 GP 3.051,72

08.4 **SCHUKO Steckdose, 1-fach, Aufputz, Reinweiß**

Wahlposition 014.1

SCHUKO Steckdose, 1-fach, Aufputz, Reinweiß
mit erhöhtem Berührungsschutz

für Aufputzmontage, Schutzart IP 44, mit zwei Leitungseinführungen; Steckklemmen: Klemmbereich für Kupferleiter 1,5 mm² und 2,5 mm², Verbindungsklemmen nach VDE 0620

Strom / Spannung: 16A, 230V
Material: Thermoplast

- Fortsetzung auf nächster Seite -

Übertrag: 4.757,76

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
08 Titel Aufputz Betriebsmittel

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 4.757,76

Farbe: Reinweiß

Fabrikat: Schneider Electric
Typ: ELSO AQUA TOP reinweiß
Art.-Nr.: 445204

liefern, montieren und betriebsfertig anschließen.

84 st EP 39,52 - Nur EP -

08.5 **SCHUKO Steckdose, 2-fach, Aufputz, Grau/Blaugrün**
Grundposition 015.0

SCHUKO Steckdose, 2-fach, Aufputz

Zum Anschließen von elektrischen Verbrauchern.
2 P + E, mit Steckanschluss, mit Klappdeckel,

Maße (H x B x T): 83 mm x 145 mm x 55 mm
Nennstrom: 16 A
Schutzart Gerät: IP 44
Farbe/Bezeichnung: grau/blaugrün

Fabrikat Busch-Jaeger Elektro GmbH
Typ: OCEAN
Art.-Nr.: 20/2 EW-53

liefern, montieren und betriebsfertig anschließen.

126 St EP 45,12 GP 5.685,12

08.6 **SCHUKO Steckdose, 2-fach, Aufputz, Reinweiß**
Wahlposition 015.1

SCHUKO Steckdose, 2-fach, Aufputz, Reinweiß
mit erhöhtem Berührungsschutz

für Aufputzmontage, Schutzart IP 44, mit zwei Leitungseinführungen; Steckklemmen: Klemmbereich für Kupferleiter 1,5 mm² und 2,5 mm², Verbindungsklemmen nach VDE 0620

Strom / Spannung: 16A, 230V
Material: Thermoplast
Farbe: Reinweiß

Fabrikat: Schneider Electric
Typ: ELSO AQUA TOP perlweiß
Art.-Nr.: 445450

liefern, montieren und betriebsfertig anschließen.

126 St EP 56,68 - Nur EP -

Übertrag: 10.442,88

Angebots-LV

HDU-Aufstockung (2204)

01	LV	Elektroinstallation
08	Titel	Aufputz Betriebsmittel

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Summe Titel 08

Aufputz Betriebsmittel, Netto: **10.442,88 EUR**

Leistungsverzeichnis

Leistung (Titel)

09

Blitzschutz

Angebots-LV

01	LV	**Elektroinstallation**
09	Titel	Blitzschutz

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

09.1 Grundposition 016.0

Fangstange Ø 16 mm2 und Gesamtlänge 1500mm

Fangstange Ø 16 mm2 und Gesamtlänge 1500mm

Zum Schutz von Dachaufbauten, Kaminen usw.
Auch zum Errichten mit Betonsockel.

Gesamtlänge: 1500 mm
Werkstoff: AlMgSi
Durchmesser Ø: 16 mm2
Normenbezug: DIN EN 62561-2

Fabrikat: DEHN
Typ: FS 16 1500 AL
Art.-Nr.: 104150

liefern, montieren und betriebsfertig anschließen.

126 St EP 40,22 GP 5.067,72

09.2 Wahlposition 016.1

Fangstange Ø 16 mm2 und Gesamtlänge 2000mm

Fangstange Ø 16 mm2 und Gesamtlänge 2000mm

ab einer freien Länge von >2,5 m ist eine
zusätzliche Befestigung, z. B. isolierte
letzter Meter verjüngt von Ø 16 mm auf Ø 10 mm,
Material: AlMgSi
passend zum Standfuß-System FangFix

Werkstoff: AlMgSi
Länge: 2000 mm
Nenngröße Ø: 10/16 mm2
Gewicht: 0,55 kg

Fabrikat: OBO BETTERMANN
Typ: 101 VL2000
Art.-Nr.: 5401983

liefern, montieren und betriebsfertig anschließen.

126 St EP 45,76 - Nur EP -

09.3 KG: -

Fix Klemme zur Montage Rundleiter an Fangstange

Fix Klemme zur Montage Rundleiter an Fangstange

FangFix-Klemme aus VA für RD 8 mm
Geprüft mit H (100 kA) nach DIN EN 50164-1
pasend für Rohr-Fangstangen Ø 16 mm
Montage des Rundleiters an der Fangstange mit nur
einer Schraube.

Werkstoff: Edelstahl, rostfrei Werkstoff 1.4301
Gewicht: 0,087 kg

- Fortsetzung auf nächster Seite - Übertrag: 5.067,72

Angebots-LV

01 LV Elektroinstallation
09 Titel Blitzschutz

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 5.067,72

Fabrikat: OBO BETTERMANN
Typ: F-FIX-KL
Art.-Nr.: 5403219

liefern, montieren und betriebsfertig anschließen.

126 St EP 17,11 GP 2.155,86

09.4 **UF-Trennstellenkästen Ausführung Kunststoff**
Grundposition 017.0

UF-Trennstellenkästen Ausführung Kunststoff

UF-Trennstellenkästen für Unterflurmontage
Mit eingebauter, gut zugänglicher Trennstelle (mit einem Schlüssel lösbar), inklusive Anschluss für die Ableitung und die Erdleitung, unten offen (ohne Boden).

Werkstoff: Kunststoff
Abmessung: 197 x 197 x 204 mm
Werkstoff Trennstelle: NIRO

Fabrikat: DEHN
Typ: UFTSK 7.10 FL40 197X197X204 K
Art.-Nr.: 549050

liefern, montieren und betriebsfertig anschließen.

42 St EP 115,92 GP 4.868,64

09.5 **UF-Trennstellenkästen Ausführung Nichtrostender Stahl**
Wahlposition 017.1

Wie Position 09.4 jedoch:
UF-Trennstellenkästen Ausführung Nichtrostender Stahl

Werkstoff: NIRO
Abmessung: 200 x 200 x 105 mm
Werkstoff Trennstelle: NIRO

Fabrikat: DEHN
Typ: UFTSK 7.10 FL40 200X200X105 V2A
Art.-Nr.: 549090

liefern, montieren und betriebsfertig anschließen.

42 St EP 223,75 - Nur EP -

09.6 **Leitungshalter Typ KF2 (lose) für Flachdach**
Grundposition 018.0

Leitungshalter Typ KF2 (lose) für Flachdach

Dachleitungshalter, für Flachdächer zur Befestigung von Rundleitern auf Flachdächern mit 2-facher Leitungshalterung

- Fortsetzung auf nächster Seite -

Übertrag: 12.092,22

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
09 Titel Blitzschutz

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 12.092,22

Typ KF2, zum Einklemmen in Dachbahnenstreifen (Stärke bis 5 mm), der mit der Dachbahn verschweißt oder verklebt ist, aus wetterbeständigem Kunststoff, UV-stabilisiert.

Leitungsführung: lose
Werkstoff Leitungshalter: Kunststoff
Leitungshalter Aufnahme Rd: 8 mm

Fabrikat: DEHN
Typ: DLH KF2 8 LO 141X86X70
Art.-Nr.: 253051

liefern, montieren und betriebsfertig anschließen.

840 St EP 8,71 GP 7.316,40

09.7 **Dachleitungshalter für Flachdach mit Befestigungsloch**
Wahlposition D18.1

Dachleitungshalter für Flachdach mit Befestigungsloch

Dachleitungshalter, für Flachdächer mit Befestigungslöchern zum Verlegen von Fangeinrichtungen auf Flachdächern und Wänden mit Leitungshalter DEHNQUICK.

Werkstoff Dachleitungshalter: St/tZn
Abmessung: 50 x 60 mm
Werkstoff Leitungshalter: St/tZn

Fabrikat: DEHN
Typ: DLH DQ 6.10 GP50X60 STTZN
Art.-Nr.: 202030

liefern, montieren und betriebsfertig anschließen.

840 St EP 18,00 - Nur EP -

09.8 **Aderleitung H07-U 1x16mm2**
KG: -

Aderleitung H07-U 1x16mm2, nach VDE 0285-525-2-31.

Bestimmt für die Verlegung in Rohren auf, in und unter Putz sowie in geschlossenen Installationskanälen.
Für die innere Verdrahtung von Geräten, Schaltanlagen und Verteilern sowie für geschützte Verlegung in und an Leuchten mit einer Nennspannung bis 1000 V Wechselspannung oder einer Gleichspannung bis 750 V gegen Erde.

Merkmal-Bezeichnung	Ausprägung
Leiter-Material	Kupfer
Leiter-Form	rund
Leiter-Klasse Kl.1	eindrähtig
Ader-Zahl	1

- Fortsetzung auf nächster Seite -

Übertrag: 19.408,62

Angebots-LV

01 LV Elektroinstallation
09 Titel Blitzschutz

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	19.408,62
	Werkstoff der Aderisolation Polyvinylchlorid (PVC) Zul. max. Leitertemperatur 70 °C Schutzleiter Nein Schirm Nein Bewehrung/Armierung ohne Mantelmaterial ohne Mantel-Farbe ohne Brandverhaltensklasse nach EN 13501-6 Eca Halogenfrei nach EN 60754-1/2 Flammwidrig nach EN 60332-1-2 Raucharm nach EN 61034-2 Nein Zul. Kabelaußentemperatur bei Montage/Handling 5 <=> 70 °C Zul. Kabelaußentemperatur nach Montage ohne Erschütterung -40 <=> 70 °C Nennspannung U0 450 V Nennspannung U 750 V Biegeradius min. 4 x Außen-Ø Zul. Kurzschlusstemperatur 160 °C Fabrikat: LAPP Kabel liefern, montieren und betriebsfertig anschließen.			
		462 m	EP 6,85	GP 3.164,70
Summe Titel 09			**Blitzschutz, Netto:**	**22.573,32 EUR**

Leistungsverzeichnis

Leistung (Titel)

10

PV Installation

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
10 Titel PV Installation

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

10.1 **PV-Batterie-Box 8,0 kWh** KG: -

PV-Batterie-Box 8,0 kWh

PV Batteriespeicherbox, kompatibel mit angebotenem 1-Phasen Wechselrichter für Off-Grid- Anwendung.

Technische Daten

Anzahl Batteriemodule:	2
Nutzbare Kapazität [1]:	8 kWh
Max. Ausgangsstrom [2]:	130 A
Peak Ausgangsstrom [2]:	180 A, 5 s
Nennspannung:	51,2 V
Spannungsbereich:	40-57,6 V
Abmessungen (H/W/T):	711 x 650 x 298 mm
Gewicht:	109 kg
Umgebungstemperatur:	-10 °C bis +50°C
Zelltechnologie:	Lithium-Eisen-Phosphat-Batterie (Kobaltfrei)
Schnittstellen:	CAN / RS485
IP Schutzart:	IP55
Batteriewirkungsgrad:	=95%
Parallelverschaltung:	Max. 16 LV 16.0 Parallel (256 kWh)
Zertifizierung:	VDE2510-50 / IEC62619 / CE / CEC / UN38.3
Anwendung:	ON Grid / ON Grid + Backup / OFF Grid

Inklusive
- 1x BMU
  1x Standfuß & Abdeckung
  sowie 2 Batteriemodulen

Fabrikat:	BYP
Typ:	B-Box Premium
Art.-Nr.:	112810

liefern, montieren und betriebsfertig anschließen.

42 St EP 4.891,98 GP 205.463,16

10.2 **Wechselrichter, 5kW** KG: -

Wechselrichter, 5kW

Einphasig, trafoloses Gerät für Privathaushalte. Mit serienmäßig integriertem Kommunikationspaket mit WLAN,

Kenndaten:
- Offene Schnittstellen (WLAN, LAN → , Modbus TCP SunSpec)
- Integrierter Datalogger und Webserver
- Integrierter Wifi Hotspot für kabellose Inbetriebnahme und Einstellungen
- Dynamic Peak Manager (hocheffizientes

- Fortsetzung auf nächster Seite -

Übertrag: 205.463,16

Angebots-LV

01 LV Elektroinstallation
10 Titel PV Installation

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 205.463,16

Verschattungsmanagement)
- integrierte Power Control Card-Funktion für Dynamisches Einspeisemanagement (Nulleinspeisung)
- integriertes Energiemanagement Relais
- sehr breiten Eingangsspannungsbereich
- frei programmierbaren S0-Eingang
- Möglichkeit zum einfachen Komponententausch

Technische Kenndaten

Max. Eingangsspannung:	1000 V
MPP-Spannungsbereich:	240 - 800 V
Anzahl MPP-Tracker:	2
Max. Wirkungsgrad:	98,1 %
Euro Wirkungsgrad:	95,1
AC-Nennleistung:	5000 W
Netzanschluss:	1 ~ NPE 220 V / 230 V (180 V - 270 V)
Klirrfaktor:	< 5 %
Leistungsfaktor:	0,85 – 1 ind. / cap
Umgebungstemperatur:	-40 bis +55°C
H x B x T (mit 100 mm Sockel):	645 x 431 x 204 mm
Gewicht:	21,5 kg
Schutzart:	IP 65

Fabrikat: FRONIUS
Typ: FRONIUS PRIMO 5.0-1
Art.-Nr.: 4.210.663

liefern, montieren und betriebsfertig anschließen.

42 St EP 1.347,17 GP 56.581,14

10.3 **Photovoltaik Modulfläche mit einer Gesamtleistung von 4,24 kWp** KG: -

Photovoltaik Modulfläche mit einer Gesamtleistung von 4,24 kWp

in der Anordnung
2 PV Module übereinander und 4 PV Module nebeneinander.
Also 8 Module gesamt.

Bei den verwendeten Modulen handelt es sich um hocheffiziente Module des Typs HiKu6 Mono PERC CS6W-530 von Canadian Solar.

Geringe Leistungsdegration von weniger als 0,55% pro Jahr über einen Betrachtungszeitraum von 20 Jahren, hocheffizientes Verhalten bei Teilverschattung durch dreifachen Zellbypass, sowie hoher Modulfestigkeit und Belastbarkeit durch Schnee- und Windlasten.

Es werden alle gängigen Normen und Vorschriften erfüllt.

- Fortsetzung auf nächster Seite -

Übertrag: 262.044,30

Angebots-LV

01 LV Elektroinstallation
10 Titel PV Installation

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Übertrag: 262.044,30

Zell-Typ:	Monokristallin
Zellanordnung:	144 [2 x (12 x 6)]
Abmessung:	2261 x 1134 x 35 mm
Gewicht pro Modul:	27.8 kg
Forntabdeckung:	3,2 mm Glas
Rahmenmaterial:	Aluminium
Anschluss-Box:	IP68, 3 Bypass Dioden
Temperaturbereich:	-40°C ~ +85°C

Kenndaten unter STC:

Pmax:	530 W
Vmp:	40.9 V
Imp:	12.96 A
Voc:	48.8 V
Isc:	13.80 A
Modul Effizienz:	20.7%

Modulfläche inklusive
- Module
- Zusätzlicher Kabel- und Leiteraufwand

Ohne
- Befestigungsvorrichtung

Fabrikat:	Canadian Solar
Typ:	HiKu6 Mono PERC
Art.-Nr.:	CS6W-530

liefern, montieren und betriebsfertig anschließen.

42 St EP 2.212,11 GP 92.908,62

10.4 **Photovoltaik - Befestigungssystem für Modulfläche** KG: -

Photovoltaik - Befestigungssystem für Modulfläche

Das Montagesystem passend zur Modulfläche setzt sich aus mehreren Einzelpositionen der Firma Schletter zusammen.

Befestigungssystem, ausgelegt zur Befestigung von gerahmten Solarmodulen mit Rahmendicken von 30-50 mm. Das System ist für handelsübliche Photovoltaik Module gleichermaßen geeignet. Das System erfüllt erhöhte ästhetische Ansprüche und besitzt eine hohe Toleranz bezüglich der Modulabmessungen. Es ermöglicht sowohl eine quer als auch eine hochkant Montage der Photovoltaik Module. Die Befestigung des Systems erfolgt direkt an den Dachlatten.

Die Photovoltaik Module werden mittels Modulklemmen an den Montageschienen des Systems befestigt. Das Befestigungskonzept erlaubt es jedes einzelne Photovoltaik

- Fortsetzung auf nächster Seite -

Übertrag: 354.952,92

Angebots-LV

01 LV Elektroinstallation
10 Titel PV Installation

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	354.952,92
	Modul unabhängig von den anderen Modulen auszubauen bzw. auszutauschen. Die Lüftungshöhe unter den Photovoltaik Modulen soll mindestens 49 mm betragen, um einen Leistungsverlust durch Modulerhitzung zu minimieren. Das System beinhaltet eine Aluminiumeinblechung zur einfachen seitlichen und oberen Anbindung an Dachpfannen und Wasserabdichtung. Montagesystem bestehend aus den Hauptkomponenten: - Modultragprofil aus Aluminium 50x30 mm - Mittel- und Endklemmen zur Modulbefestigung - Verschraubungs- und Befestigungsmaterial Fabrika: Schletter Typ: Montagesystem PV iefern, montieren und betriebsfertig anschließen.	**42 St**	EP 434,24	GP 18.238,08
Summe Titel 10			**PV Installation, Netto:**	**373.191,00 EUR**

Leistungsverzeichnis

Leistung (Titel)

11

Anschlussarbeiten HLS

Angebots-LV

01 LV Elektroinstallation
11 Titel Anschlussarbeiten HLS

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
11.1	**Anschließen Lüftungsgerät** KG: - Anschließen Lüftungsgerät Vollständige elektrische An. und Einbindung des vom Gewerk HLS installierten und angeschlossenen Lüftungsgeräten des Typs Meltem M-WRG II. Inklusive: - Anklemmarbeiten - Elektrische Kabel - Elektrische Klemmen - Isolierarbeiten - etc.	**42 St**	EP 21,36	GP 897,12
11.2	**Anschließen Wärmepumpe** KG: - Anschließen Wärmepumpe Vollständige elektrische An. und Einbindung der vom Gewerk HLS installierten und angeschlossenen Wärmepumpe des Typs ecoGeo der Firma EcoForest. Inklusive: - Anklemmarbeiten - Elektrische Kabel - Elektrische Klemmen - Isolierarbeiten - etc.	**42 St**	EP 21,36	GP 897,12

Summe Titel 11

Anschlussarbeiten HLS, Netto: 1.794,24 EUR

Leistungsverzeichnis

Leistung (Titel)

12

Stundenlohnarbeiten

Angebots-LV

HDU-Aufstockung (2204)

01 LV Elektroinstallation
12 Titel Stundenlohnarbeiten

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

Stundenlohnarbeiten werden in den nachfolgenden Mengen

Stundenlohnarbeiten werden in den nachfolgenden Mengen angesetzt.

Abgerechnet werden nur die beauftragten, tatsächlich angefallenen Stundenlohnleistungen über die Positionen mit dem angegebenem Verrechnungssatz. Arbeiten auf Nachweis dürfen nur nach vorheriger Genehmigung durch den Auftraggeber ausgeführt werden. Darüber hinaus werden dem Auftraggeber täglich Nachweise in doppelter Ausfertigung vorgelegt.

Es finden unter Anrechnung aller Unkosten- Aufsichts-, Wege- und Trennungsgelder, Auslösungen etc. sowie Vorhaltung aller Werkzeuge und Geräte folgende Lohnsätze Anwendung.

***Bedarfspos.
12.1 **Stundenlohnarbeiten Meister** KG: -

Stundenlohnarbeiten Meister

einschl. aller Nebenkosten, wie Auslösung, Fahr- und Wegegeld, Unternehmerzuschlag etc.

Ausführung nur nach schriftlicher Genehmigung der Bauleitung und bestätigtem Nachweis.

84 h EP 73,82 - Nur EP -

***Bedarfspos.
12.2 **Stundenlohnarbeiten Facharbeiter** KG: -

Stundenlohnarbeiten Facharbeiter

einschl. aller Nebenkosten, wie Auslösung, Fahr- und Wegegeld, Unternehmerzuschlag etc.

Ausführung nur nach schriftlicher Genehmigung der Bauleitung und bestätigtem Nachweis.

168 h EP 62,02 - Nur EP -

***Bedarfspos.
12.3 **Stundenlohnarbeiten Helfer** KG: -

Stundenlohnarbeiten Helfer

einschl. aller Nebenkosten, wie Auslösung, Fahr- und Wegegeld, Unternehmerzuschlag etc.

Ausführung nur nach schriftlicher Genehmigung der Bauleitung und bestätigtem Nachweis.

84 h EP 56,55 - Nur EP -

Summe Titel 12

Stundenlohnarbeiten, Netto: -

Leistungsverzeichnis

Leistung (Titel)

13

Sonstiges

Angebots-LV

01 LV Elektroinstallation
13 Titel Sonstiges

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)

13.1 **Bedienung Baukran durch geschultes Fachpersonal** KG: -

Bedienung Baukran durch geschultes Fachpersonal
Für Baukräne mit Fernsteuerung.

Nutzung des bauseits den Gewerken zur Verfügung gestellten Baukrans zum Transport von Material seitens der Elektroinstallation, wie z.B. Batteriespeicher, PV-Module, Zählerschränke, etc.

Der Baukran wird seitens Elektro nur intervallweise zum Transport größerer Materialmengen benutzt, um die notwendige Anwesenheit des geschulten Kranführers zu minimieren.

1 psch GP 5.854,15

13.2 **Einrichten Baucontainer** KG: -

Einrichten Baucontainer

Einrichten eines Baucontainers auf bauseits zur Verfügung gestelltem Gelände zur Zwischenlagerung von häufig verwendetem Kleinmaterial und Installationsgeräten.

Inklusive
- Anfahrt
- Aufstellung

1 psch GP 354,75

13.3 **Vorhalten Baucontainer für 3 Monate** KG: -

Vorhalten Baucontainer für 3 Monate

Vorhalten eines Baucontainers für eine Bauzeit von 3 Monaten auf bauseits zur Verfügung gestelltem Gelände zur Zwischenlagerung von häufig verwendetem Kleinmaterial und Installationsgeräten.
Der Baucontainer ist während der Vorhaltedauer an den bauseits gestellen Baustrom angeschlossen

1 psch GP 756,80

13.4 **Räumen Baucontainer** KG: -

Räumen Baucontainer

Räumen des Baucontainers von bauseits zur Verfügung

- Fortsetzung auf nächster Seite -

Übertrag: 6.965,70

Angebots-LV

01 LV Elektroinstallation
13 Titel Sonstiges

Nr.	Leistungsbeschreibung	Menge/ Einh.	Preis (EP)	Gesamt (GP)
			Übertrag:	6.965,70
	gestelltem Gelände zur Zwischenlagerung von häufig verwendetem Kleinmaterial und Installationsgeräten. Inklusive - Abbau - Abfahrt	**1 psch**	GP	354,75
13.5	**Anträge für Zähler und Netzabfragen beim Versorger** Anträge für Zähler und Netzabfragen beim Versorger Pauschal abgerechnet für das gesamte Bauvorhanden mit 42 Wohneinheiten uns somit 42 separaten Anträgen beim Netzversorger. Übermittlung in Papierform und digital in PDF.	**1 psch**	GP	KG: - 4.211,36
***Bedarfspos. **13.6**	**Sachverständigenabnahme** Sachverständigenabnahme Abnahme der gesamten vorher beschriebenen Elektroanlage Teil Starkstromanlagen. Durch einen Gutachter wie TÜV, DEKRA bzw. einen bauaufsicht zugelassenen amtlich vereidigten Sachverständigen einschließlich aller notwendigen Unterlagen und Dokumenten. Die Abnahme der gesamten Anlage hat vor der ersten Inbetriebnahme zu erfolgen.	**42 St**	EP 73,82	KG: - - Nur EP -

Summe Titel 13

Sonstiges, Netto: 11.531,81 EUR

LV-Zusammenfassung

HDU-Aufstockung (2204)

01 LV Elektroinstallation

Nr.	Bezeichnung		Seite	Gesamt in EUR
01	Titel	Potentialausgleich	4	4.556,16
02	Titel	Zählerschrank Wohnungen und Bestückung	7	174.840,54
03	Titel	Unterverteiler Wohnungen und Bestückung	27	20.282,64
04	Titel	Verlegesysteme	33	220.810,80
05	Titel	Kabel und Leitungen	39	115.460,10
06	Titel	Elektro-Klemmen	44	9.397,08
07	Titel	Installationsgeräte	48	53.038,02
08	Titel	Aufputz Betriebsmittel	56	10.442,88
09	Titel	Blitzschutz	61	22.573,32
10	Titel	PV Installation	66	373.191,00
11	Titel	Anschlussarbeiten HLS	71	1.794,24
12	Titel	Stundenlohnarbeiten	73	-
13	Titel	Sonstiges	75	11.531,81

Gesamtsumme: LV 01 Elektroinstallation

Gesamtsumme, Netto:	**1.017.918,59 EUR**
zzgl. MwSt. (19,0 %):	193.404,53 EUR
Gesamtsumme, Brutto:	**1.211.323,12 EUR**

04 Appendix

CESA Report

Table 1 – Measurements of communication

Measures of the Communication	Visitors SDE Wuppertal	Publicity Rosenheim	Publicity Wuppertal	Students Universities	Sponsors	Customers Industry	Tenants / Buyers
Online Measures							
Website	X	X	X	X	X	X	X
Social Media (facebook, Instagram, LinkedIn)	X	X	X	X	X	X	
Video Concept Level up							
Newsletter					X	X	
Digital simulation of flexible living concepts	X			X	X	X	X
Offline Measures							
Public Relations (Press, Radio, TV)		X	X				
Brochures					X		X
Professional article		X			X	X	
Events	X	X		X			X
Fairs / Exhibitions				X	X	X	X
Lectures		X				X	
Posters	X						
Visits to building projects		X		X		X	X
Integration of company logo					X		
Guided tours and workshops	X	X	X	X			

Table 2 – Online activities

	Apr 20	Mai 20	Jun 20	Jul 20	Aug 20	Sep 20	Okt 20	Nov 20	Dez 20	Jan 21	Feb 21	Mrz 21	Apr 21	Mai 21	Jun 21	Jul 21	Aug 21	Sep 21	Okt 21	Nov 21	Dez 21	Jan 22	Feb 22	Mrz 22
Social Media																								
Facebook				5	3		1	14	9	10	3	5	5	5	11	9	5	6	5	4	9	12	19	8
Instagram				5	3		1	14	9	10	3	5	5	5	11	9	5	6	5	4	9	12	19	8
YouTube								1	1				1											
Linked In										3	3	1	4	3	3	5	5	2	3	2	7	2	1	1
Website							1		1	1	1				1									
Newsletter															1					1				
Podcast													1		1	1			2	1	1		1	1
Radio																								
Presse	1		1								2	4		1	1	1	1	2			1	4	1	2
Konferenzen						1	1	1		2	1	1	2	1	1			1	2	1			1	1

Table 3 – SWOT Analysis Social Awareness

Germany:

Strength	Weakness	Opportunities	Threats
• Most economically powerful • Country in the EU • A good labor market • Statutory social assistance	• Demographic change • High proportion of people over 60 • Insufficient supply of care • High stock of old buildings • 75% of all buildings are classified as energy inefficient	• Especially young people (20-40 years) move to big cities • Income inequality Gap between rich and poor is growing • Energy turnaround by 2050: goal of a climate-neutral building stock and the supply of renewable energies • Support for renovation and modernization	• Housing shortage • Sharp rise in rents. But rent brake is supposed to slow down rent increases • Lack of barrier-free housing • High political requirements for the energy efficiency of buildings

Rosenheim:

Strength	Weakness	Opportunities	Threats
• Rural region with proximity to Munich and Austria • Tourist region • Economically strong city with high income structure • University with 6000 students • Population growth • High quality of life	•Smaller town with 60,000 inhabitants • Growth of the older population • High traffic volume • Lack of parking space	• Support for the provision of affordable housing, e.g. for trainees, students • Promotion of space-saving and high-quality housing construction in integrated locations • Promotion of timber construction	• Mixture of single-family houses with multi-storey apartment buildings • Lack of affordable housing • High print runs with regard to energy

Wuppertal

Strength	Weakness	Opportunities	Threats
• Economic and cultural center of the Bergisches Land • University town • City in the country • Central location of the city	• Old building stock • Confined development • Equipment of the apartments (e.g. missing balconies) no longer meets the current requirements of the users • Only few solar roofs	• The reidentification, the addition of storeys and the extension of residential buildings are now more easily possible due to the changes in the building regulations for Wuppertal (Haus und Grund Wuppertal) • Current the main incentive for investment in the housing stock	• Decline in social housing leads to a supply problem in the Wuppertal housing market • High building regulations, e.g. in the case of changes of use • Land requirements for new residential construction not covered • Planning and approval practices of the municipality that need improvement

Spoken parts - Audiovisual

Introduction:

Hey, servus, hey, we are team levelup from Rosenheim and we are proud to be part of the solar decathlon Europe 2021 and we are working on a concept to levelup our future living.

Interviews:

Andreas Boschert:
In the Solar Decathlon Project there are many different disciplines from architecture, engineering and construction, affordability and viability but also communication and other innovative technologies.

Jakob Werner:
We developed a concept for buildings from the 1950s and the 1970s because most of the buildings in Germany are from this time period and these buildings are using five times more energy than new ones and we thought this is a massive problem and we want to change it.

Jakob Werner:
In our concept we renovate the actual building and we are using a lot of renewable energies and technologies like solar panels, photovoltaic or even bioreactors and in addition of isolation we can archive a really low energy usage

Andreas Boschert:
With our concept, the addition of storeys in modular timber construction we can increase the amount of housing in Germany especially in urban areas that is a potential from over one million new flats we could generate just with our levelup system and also we are renovating the existing building so we can archive a very environmental friendly and future orientated house
Our levelup system is planned in timber modular design which is why we can reduce construction costs and time

Julia Paternoster:
We are developing a addition of storeys for a building in Nuremberg which is representative for the buildings from the 1970s and for that, we are at the moment building our house demonstration unit next to the TH Rosenheim which shows a small part of the whole building

Julia Paternoster:
Our addition of storeys, we are building more timber modules with bigger spaces or smaller spaces.

Julia Bachmaier:
So we are not only planning on adding apartments on top of the existing building we are also planning on creating roof areas with greenfield areas on top of the building so the community can come together on the roof and hang out, have there time together and build a real community in the whole building

Andreas Boschert:
With using the photovoltaic system on the addition of storeys we have new potential using solar thermal and photovoltaic to generate electricity and warm water and that's great because it´s just renewable energy and that´s what we need for our future of cities.

Julia Bachmaier:
So our vision is that in the existing right now there is the older generation living there and with the extension of storeys we are thinking about younger people to move in and helping those older generations in all kinds of situations of the life for example go food shopping for them or helping them repair stuff.

levelup

SDE Competition
Team 2021
TH Rosenheim

... goes business!

Sponsorship Manual

solar decathlon europe 21>22
WUPPERTAL GERMANY ...goes urban!

Technische Hochschule Rosenheim

The competition in a nutshell

Solar Decathlon Europe 21/22 (SDE 21/22) is an international, interdisciplinary, architectural competition in which technical universities compete head-to-head with the primary goal of designing, constructing, and operating completely solar-powered buildings for the future of climate-neutral living. Spanning a period of over two years, 18 teams from eleven countries each develop a „solar building of the future“, then construct a 1:1 demonstrator building, called a House Demonstration Unit (HDU), which will be judged by a renowned jury of experts. Points are awarded based on ten design and construction contests that are driven by the core disciplines of architecture, communication, comfort, sustainability, and energy performance. The focus is on sustainable building and living in cities, and aims to address current urban challenges. The fully-functional HDUs will be open to the public as they are being evaluated in Wuppertal, Germany from the 10th – 26th of June this year. As one of the most influential competitions in the world, SDE celebrates its 20th anniversary while being hosted in Germany for the first time. Organizers expect over 150,000 visitors from all over the world for the final event.

Our vision of a climate-neutral building stock

Our project is searching for ideas and solutions to solve one of the greatest challenges currently facing the housing sector: the creation of new and affordable living space coupled with the conversion to a climate-neutral building stock. For this purpose, the Rosenheim University of Applied Sciences and its levelup project team are developing adaptable, easily to prefabricate, modular-timber units. Since a vast majority of Germany’s current housing stock was built between the 1950s to the 1970s - before the first heat-insulation ordinance of 1977 - levelup is focusing on these building types, which account for the largest proportion of ‘primary and final energy consumption’. According to the estimates, more than 1.1 million new apartments could be built in Germany’s urban areas by adding storeys on existing buildings. Notably, this can be done without building upon valuable green areas. levelup’s competition entry develops transferable and substantial solutions to assist Germany’s federal government to reach its objective of an essentially climate-neutral building stock by 2045.

We - the team levelup - want to create sustainable, climate-neutral and affordable housing that adapts to different building types and sizes and the individual lifestyles and needs of different population groups (social diversity) through flexible use. The details of interior design and technology enhances the daily life and the environment!
To not seal any more green space, we are adding stories to existing buildings. Thereby we improve the energy efficiency of the entire building and enhance German city centers not only architecturally and aesthetically, but also socially.
levelup your … living.

Our university team levelup

Our team consists of many curious minds with a healthy mix of visionary ideas, engineering expertise, creativity, and interdisciplinary drive!

www.levelup-ro.de

@levelup_ro

@levelup Rosenheim

@levelup

Cooperation and services for our partners

Project team „levelup“ is looking forward to your support.

After our enormous accomplishment as „ the best German and European participant, winning 2nd place, at the Solar Decathlon Europe 2010“ in Madrid, we would like to continue this success story with you. The competition strengthens and promotes technology and innovation and offers the opportunity to present German know-how to interested visitors from all over the world. Experience has shown that a very large response can be expected for a university project of this magnitude.

It is also very important to us to recognize the commitment of each and every donor throughout the course of the project. We want to make sure that your support as benefactor will be rewarded. Your commitment to the project will be recorded in a written agreement (passive sponsorship contract), in which general conditions can be agreed upon individually.

Your benefits at a glance:

- Listing as our partner, with your logo, in various print and online media
- PR affiliation with innovative building driven by a very large media interest (films, trade journals, conference contributions, website, events)
- Long-term image enhancement
- Positioning yourself as an innovative and future-oriented partner
- Contact to other sponsors, partners, and experts
- Joint development and commercial testing of innovations in laboratories and research institutes | Proof of concept for market maturity at high Technical Readiness Levels (TRL)
- Participation and influence in the project development and, if applicable, resulting follow-up research and project realization
- Direct contact with students (potential employees)

Our partners

Company	Industry sector / fields of work	Engagement in SDE 21/22
AGC Interpane	Flat glass manufacturer and developer	Provision of insulating glas
ALPI Caneco	IT-Software and service for BIM	Provision of BIM software
ALPI Deutschland GmbH	IT-Software and service for BIM	Provision of BIM software
auxalia GmbH	IT-Software and service for BIM	Provision of BIM software
B&O Gruppe	Housing industry	Monetary donation
Bayerischer Bauindustrieverband e.V.	Building industry association	Monetary donation
BELIMO Stellantriebe,Vertriebs GmbH	Building service engineering	Provision of equiptiment
best wood SCHNEIDER GmbH	Timber construction industry	Provision of material (timber)
BIMR	IT-Software and service for BIM	BIM support
BSH Hausgeräte GmbH	Home appliances industry	Provision of kitchen appliances
Bundesministerium für Wirtschaft und Klimaschutz	Federal Ministry	Financial support
BYD Company Limited	Energy storage systems	Provision of battery storage
Caala GmbH	Software provider for building optimization	Provision of software
CampusRo Projektentwicklungs GmbH & Co. KG	Lift manufacturer	Monetary donation
Cibes Lift Deutschland GmbH	Building industry	Provision of electric lift
CLAYTEC GmbH & Co. KG	Conference organizer	Provision of clay panels
Complex-Farben Schellhorn Josef GmbH	Food finishing	Provision of material
Conexio-PSE GmbH	Access controls and locking systems	Provision of conference tickets
Dirk Söndgerath | Innovative Heiztechnik	Energy and building technology	Support with PVT modules
dormakaba Deutschland GmbH	Engineering Office Energy and Building Technology	Provision of locking system
Duschl Ingenieure GmbH & Co. KG	Heat pump manufacturer	Monetary donation and support
Ecoforest	Construction company	Provision of heat pump
Ed. Züblin AG	Energy industry and decentralized energy systems	Provision of construction fences and containers, BIM support
EFT-Systems GmbH	Electronic components building sector	Provision of battery storage
ELTAKO GmbH	Glass manufacturer and developer	Provision of material
EPLAN GmbH & Co. KG	IT-Software	Provision of software (CAE & CAD)
Fineo by AGC	Building industry, scaffolding	Provision of vacuum insulating glass
Fischbacher Gerüstbau GmbH	Photovoltaics and battery charging tech-nology	Support scaffolder for weather protection roof

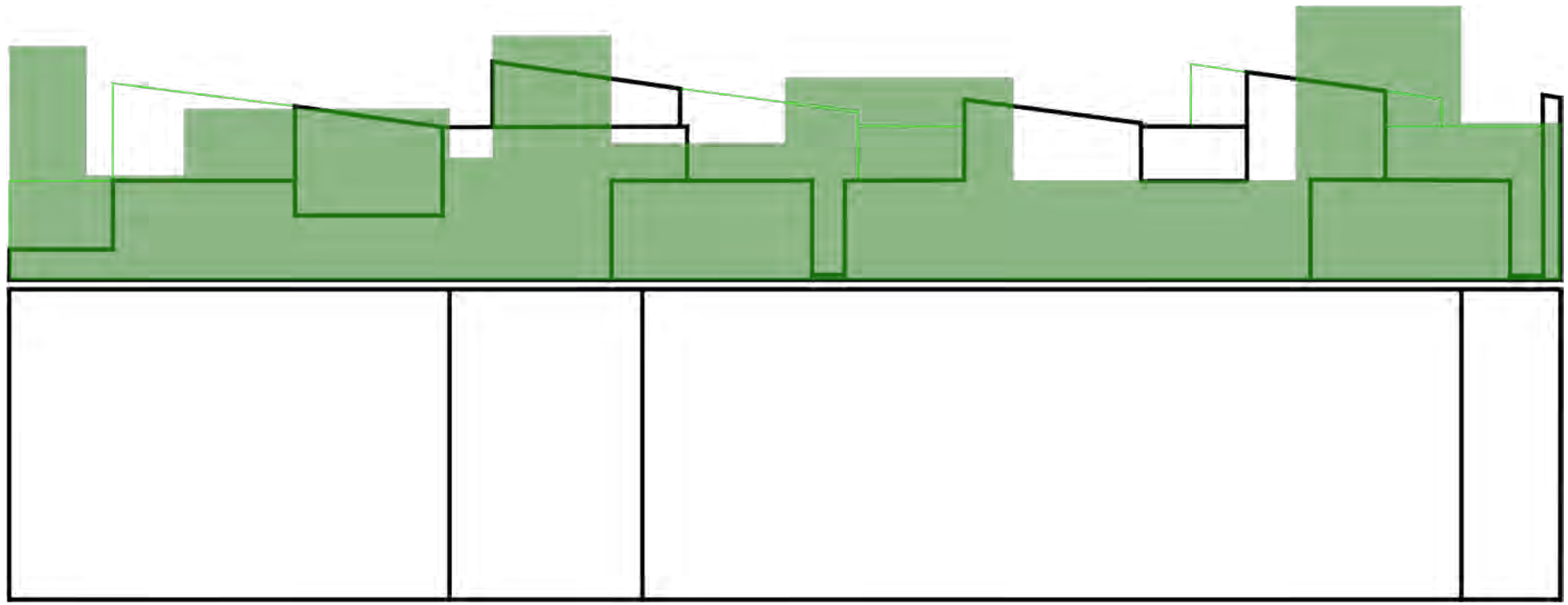
Company	Industry sector / fields of work	Engagement in SDE 21/22
Fronius Deutschland Gmbh	Housing and redevelopment company	Provision of inverters and smart meters
GKK GmbH & Co. KG	Energy and building technology	Provision of material
GRWS - Wohnungsbau - und Sanierungsgesellschaft der Stadt Rosenheim GmbH	Insulation manufacturer	Monetary donation
GUTEX Holzfaserplattenwerk H. Henselmann GmbH & Co. KG	Insulation manufacturer	Provision of wood fibre panels
Häfele SE & Co. KG	Interior fittings	Provision of material
Hamberger Flooring GmbH & Co. KG	Flooring, sawmill, agriculture and forestry	Provision of parquet and cork
Huber & Sohn GmbH & Co. KG	Timber construction manufacturer	Provision of material, working hall and tools
ift Rosenheim GmbH	Institute	Fire testing and laboratories
Instalighting GmbH	Lightning technology	Provision of devices
INTEWA GmbH	Water purification	Provision of rainwater tanks
J.N. KREILLER KG	Trading company for craft and industrial enterprises	Provision of material
James Hardie Group (Fermacell)	Fiber cerment building materials	Provision of material
Joulia SA	Sanitary technology	Provision of shower drain
KNIPEX-Werk	Tool manufacturer	Provision of tools
Konstrukt AG mit Partner Lucama	Engineer planner for profile system	Provision of membrane system
Lignotrend Produktions GmbH	Timber construction industry	Provision of wood ceilings and floors
Lindner Group KG	Building industry interior, assembly	Provision of impact sound insulation and floor heating
MDT technologies GmbH	Building automation	Provision of devices
Memodo Gmbh	Solar wholesaler	Provision of materials for PVT and PV-system
Meteotest AG	Products and service in weather, climate and more	Provision of software
Norit	Building industry interior, assembly	Provision of impact sound insulation and floor heating
OBI GmbH & Co. Deutschland KG	Construction market	Monetary donation
Oventrop GmbH & Co. KG	Provider of heat, cool and drink water solutions	Provision of fresh water station
Pichler Werkzeug GmbH	Tool manufacturer	Provision of tools
Pröbstl Holz GmbH	Timber construction industry	Provision of wood
Quest Baukultur GmbH	Real estate agency	Monetary donation
Raimund Beck KG	Building industry, fastening technology	Provision of wood nails and tools
RHEINZINK GmbH & Co. KG	Building industry, roofing systems	Provision of sheet metal roof, guttering and staff
Rieder Bau GmbH & Co. KG	Construction company	Monetary donation

Company	Industry sector / fields of work	Engagement in SDE 21/22
Robert Bosch Power Tools GmbH	Tool manufacturer	Provision of tools
Röckl Flachdachbau GmbH	Building industy, flat roof construction	Planning support
ROTHO BLAAS SRL	Timber construction industry	Provision of fasteners
Rübner Türen GmbH	Building industry, wood doors manufacturer	Provision of doors
SAILER GmbH	Fresh water stations and storage tanks	Provision of drinking water / buffer tank
Salvia Elektrotechnik GmbH	Electrical building services	Provision of material and staff
Schüller Möbelwerk KG	Kitchen manufacturer	Monetary donation
SEEONER KREIS e.V.	Regional business association	Monetary donation
Sieldungswerke Nürnberg	Housing association	Partner for Design Challenge
SIGA Cover GmbH Deutschland	Building industry	Provision of membranes and tapes
Sika Deutschland GmbH	Building industry	Provition of waterproofing material
SOLAR-COMPUTER GmbH	Software for building services	Provision of software
Solibri Inc	IT-Software and service for BIM	Provision of BIM software
SORAA	Lightning technology	Provision of devices
Sparkassenstiftung Landkreis Rosenheim	Financial services provider	Monetary donation
Sparkassenstiftung Stadt Rosenheim	Financial services provider	Monetary donation
Spenglerei Karl Banjai	Building industry	Planning support
Staatliche Fachschule Rosenheim (Holztechnik)	School for wood technology	Planning support
Staatsministerium für Wohnen, Bau und Verkehr	Department of State	Monetary donation
Steico SE	Building industry	Provision of timber walls
Sulzer Pumpen GmbH	Water and sewage technology	Provision of water and waste water pumps
SUNOVATION Produktion GmbH	Solar module manufacturer	Provision of building integrated photovoltaic
SWISS KRONO AG	Wood-based materials industry	Provision of construction panels
Tjiko GmbH	Bathroom module manufacturer	Provision of material
tobler GmbH & Co. KG / dormakaba Holding AG	Locking and security technology	Provision of locking system
Ushio Germany Gmbh	Lightning manufacturer	Provision of devices
Valentin Software GmbH	IT-Software for pv simulation	Provision of software
Vela Solaris AG	IT-Software for energy systems simulation	Provision of software
vrame Consult GmbH	IT-Software and service for BIM	BIM support
W. Markgraf GmbH & Co. KG	Construction company	Provision of steel construction

Company	Industry sector / fields of work	Engagement in SDE 21/22
WAGO Kontakttechnik GmbH	Electrical connection technology and components	Provision of building automation
Warema	Sun protection and shading	Provision of external blinds
xoio GmbH	Architecture visualizations	Support with renderings
Zimmerei Lukas Germerott GmbH	Building industry	Monetary donation and staff, working hall and machinery

levelup

SDE Competition
Team 2021
TH Rosenheim



energy endeavour
FOUNDATION

Gefördert durch:
Bundesministerium
für Wirtschaft
und Klimaschutz
aufgrund eines Beschlusses
des Deutschen Bundestages

solar
decathlon
europe
21»22
WUPPERTAL GERMANY

Gefördert durch
Bayerisches Staatsministerium für
Wohnen, Bau und Verkehr

Technische Hochschule Rosenheim

Studieren nah an der Praxis, mit unbegrenzten Möglichkeiten für die Zukunft!

Klein aber fein – exzellente Studienbedingungen und intensiver Praxisbezug Hand in Hand mit der Wirtschaft und Forschung

Als eine der wichtigsten Bildungseinrichtungen in Südostbayern verbindet die Technische Hochschule Rosenheim regionales Profil mit internationalem Renommee. Ihre Kernkompetenzen liegen in den Bereichen Technik, Wirtschaft, Gestaltung, Gesundheit und Soziales. Acht Fakultäten bieten eine praxis- und anwendungs- orientierte Ausbildung in mehr als 40 Bachelor- und Masterstudiengängen. Über 6.000 Studierende profitieren von einer exzellenten technischen Ausstattung in Werkstätten und Laboren, einer intensiven persönlichen Betreuung und einer anspruchsvollen Lehre, die ihnen überdurchschnittliche Berufsaussichten bietet.

Solar Decathlon 2021/2022

Relevanz des Forschungsprojekts

40%
des europaweiten Energieverbrauchs fallen Auf den Gebäudesektor

75%
der Gebäude werden als Energie-ineffizient eingestuft

90%
des Energieverbrauchs Fallen auf Gebäude mit Baujahr 2000 und älter

36%
aller CO2-Emissionen fallen auf den Gebäudesektor

77%
Der deutschen Bevölkerung wohnt in Städten (Urbaner Wohnraummangel)

Das Team „levelup“ besteht aus vielen neugierigen Köpfen verschiedener Studiengänge und Fakultäten und sucht im Solar Decathlon Europe 2021/22 - Wettbewerb nach Lösungen für die drängendsten Fragen der urbanen Energiewende.
Unser Erfolgsrezept liegt einer gesunden Mischung aus visionärem Vordenken, Ingenieur-Sachverstand, Kreativität und Tatkraft.

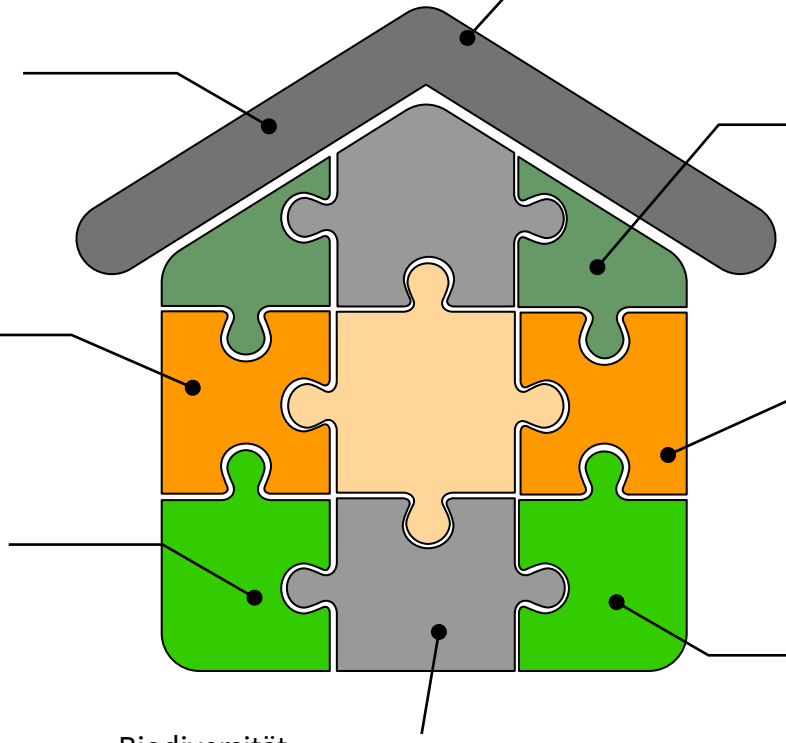
Themen und Zielsetzungen der Forschung

Relevanz und Potentiale

Digitalisierung
Weiterentwicklung von digitalisierten Planungs- und Bauprozessketten (Building Information Modeling, BIM) und Intensivierung des Dialogs der am Bau beteiligten Akteure

Klimaneutraler Gebäudebestand
Maximierung der Eigenstromversorgung durch erneuerbare Energien auf Quartiersebene.

Kreislauffähig
Konstruktionen und Materialien aus nachwachsendem, biogenem, CO2- speicherndem Baustoff Holz und rezyklierten bzw. rezyklierbaren Materialien.



Mobilität
Nachhaltige Mobilität durch Verkehrsvermeidung / Reduzierung des Individualverkehrs und Einbindung der E-Mobilität in die gebäudeintegrierte Stromversorgung.

Lehre und Forschung an der TH Rosenheim
Innovative Lehrkonzepte, interdisziplinäre Zusammenarbeit mit realer Umsetzung und Einbindung von Studierenden in aktuelle Herausforderungen des Gebäudesektors.

Aufstockung und Nachverdichtung
Innovative Nachverdichtung im urbanen Raum mittels Aufstockung der Bestandsgebäude der 1950er – 70er Jahre mit seriellem und modularem Holzbau (hoher Vorfertigungsgrad).

Erhöhung der Sanierungsrate
Entwicklung von nachhaltigen Finanzierungskonzepten mit dem Ziel zur Steigerung der Sanierungsrate und Schaffung von bezahlbarem Wohnraum („Umbau statt Abriss und Neubau“)

Biodiversität
Erweiterung des städtischen Grünanteils durch gebäudeintegrierte Begrünung

Solar Decathlon 2021/2022

Themenstellungen und Wettbewerbsablauf

Hintergrund: Nachverdichtung in den Städten mit energetischer Plusbilanz (Klimaneutraler Gebäudebestand bis 2050)

3 Wettbewerbsszenarien im urbanen Raum

- Szenario 1: Renovierung & Erweiterung
- Szenario 2: Baulücken schließen
- Szenario 3: Renovierung & Aufstockung

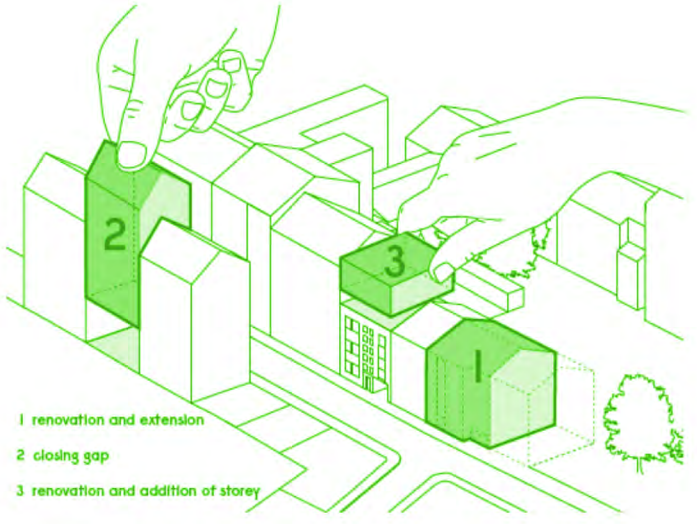


Abb. 2: Wettbewerbsszenarien des SDE21 im Überblick. © SDE21/22

Wettbewerbsablauf

Design Challenge (DC):

1. Städtebauliche Situation und soziales Szenario wählen
2. Entwurf und Energiekonzept für das gesamte Gebäude

Building Challenge (BC):

1. Repräsentative Einheit aus dem Gesamtgebäude auswählen
2. Entwurf, Bau und Betrieb der House Demonstration Unit (HDU)

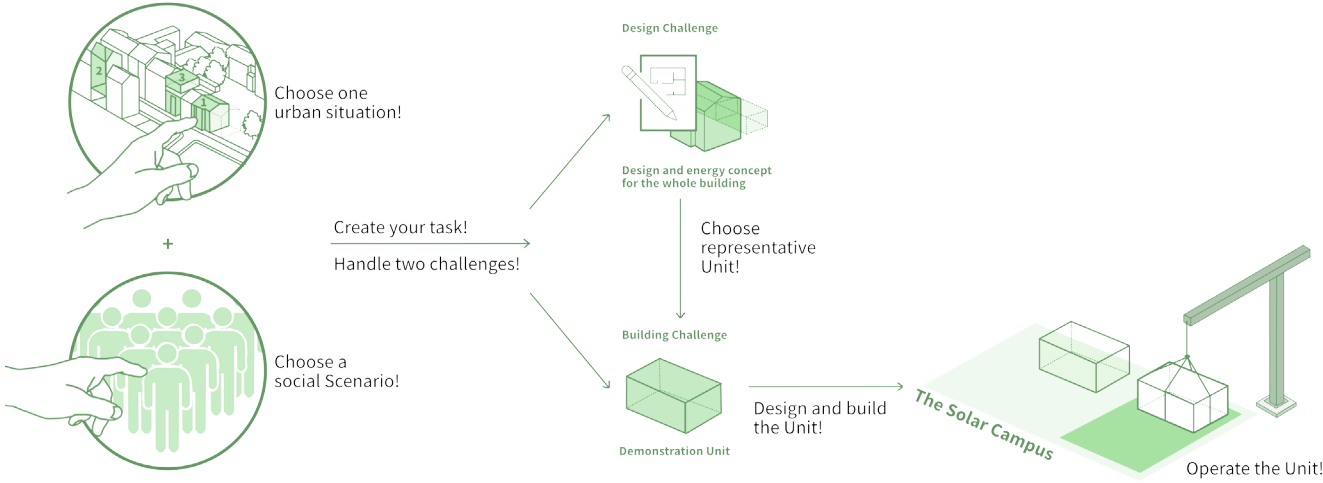


Abb. 3: Wettbewerbsablauf des SDE21. © SDE21/22

Solar Decathlon 2021/2022

Zielsetzung des Forschungsprojekts

- Modulare und kostengünstige Aufstockungen in Holz-Leichtbauweise mit hohem Vorfertigungsgrad (Bauzeitverkürzungen)
- Entwicklung von Lösungen für alle Gebäude der 1950er – 70er Jahre: Adaptierbarkeit auf unterschiedliche Grundrisstypen
- Regenerative Energien, innovatives Energiekonzept und intelligente Gebäudeautomation
- Kreislauffähige Konstruktionen aus nachwachsendem, biogenem,CO2-speicherndem Baustoff Holz und rezyklierten bzw. rezyklierbaren Materialien
- Stadtbegrünung und Biodiversität
- Nachhaltige Mobilität durch Verkehrsvermeidung und Einbindung der E-Mobilität in die gebäudeintegrierte Stromerzeugung
- Weiterentwicklung der digitalisierten Planungs- und Prozessketten vom Aufmaß über den Entwurf und die Fertigung bis zur Montage (Building Information Modeling)
- Entwicklung von nachhaltigen Finanzierungskonzepten mit dem Ziel der Steigerung der Sanierungsrate und Erstellung von bezahlbarem Wohnraum
- Intensivierung des Dialogs der am Bau beteiligten Akteure (Sponsoren aus Wirtschaft, Industrie und Forschung)

Solar Decathlon 2021/2022

Wettbewerbskriterien

Wettbewerbskriterien		Punkte	DC	BC
1	Architektur	120	✓	✓
2	Gebäudetechnik und Bauphysik	120	✓	✓
3	Energie Performance	120		✓
4	Realisierbarkeit und sozial-ökonomischen Kontext	100	✓	✓
5	Kommunikation und Bildung	80	✓	✓
6	Nachhaltigkeit	100	✓	✓
7	Komfort	100		✓
8	Funktion	80		✓
9	Urbane Mobilität	80	✓	✓
10	Innovation	100	✓	✓

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Solar Decathlon Europe 2010 · Team „Ikaros Bavaria“ der TH Rosenheim

Bester deutscher Teilnehmer, bester europäischer Teilnehmer und Vizeweltmeister!

Abb. 1: Innen- und Außenansicht der House Demonstration Unit (HDU) des Teams „Ikaros Bavaria“ der Technischen Hochschule Rosenheim beim Solar Decathlon Europe Wettbewerb 2010 in Madrid, Spanien.

Technische Hochschule Rosenheim

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SDE Competition
Team 2022
TH Rosenheim

Design Challenge

Umsetzung: Sanierung und Aufstockung

Exemplarisch demonstrieren wir unser Renovierungs- und Aufstockungskonzept an einem etwas älteren Vertreter der Zeilenbauweise, der zwischen 1939 und 1943 im Nürnberger Stadtteil Ludwigsfeld entstanden ist. In Deutschland lassen sich über 1.1. Millionen neue Wohnungen durch Aufstockung im urbanen Raum schaffen – wichtiger Wohnraum ohne die weitere Versiegelung von wertvollen Grünflächen.

Design Challenge

Die Story

Technische Hochschule Rosenheim

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SDE Competition Team 2022 TH Rosenheim

Key Facts:

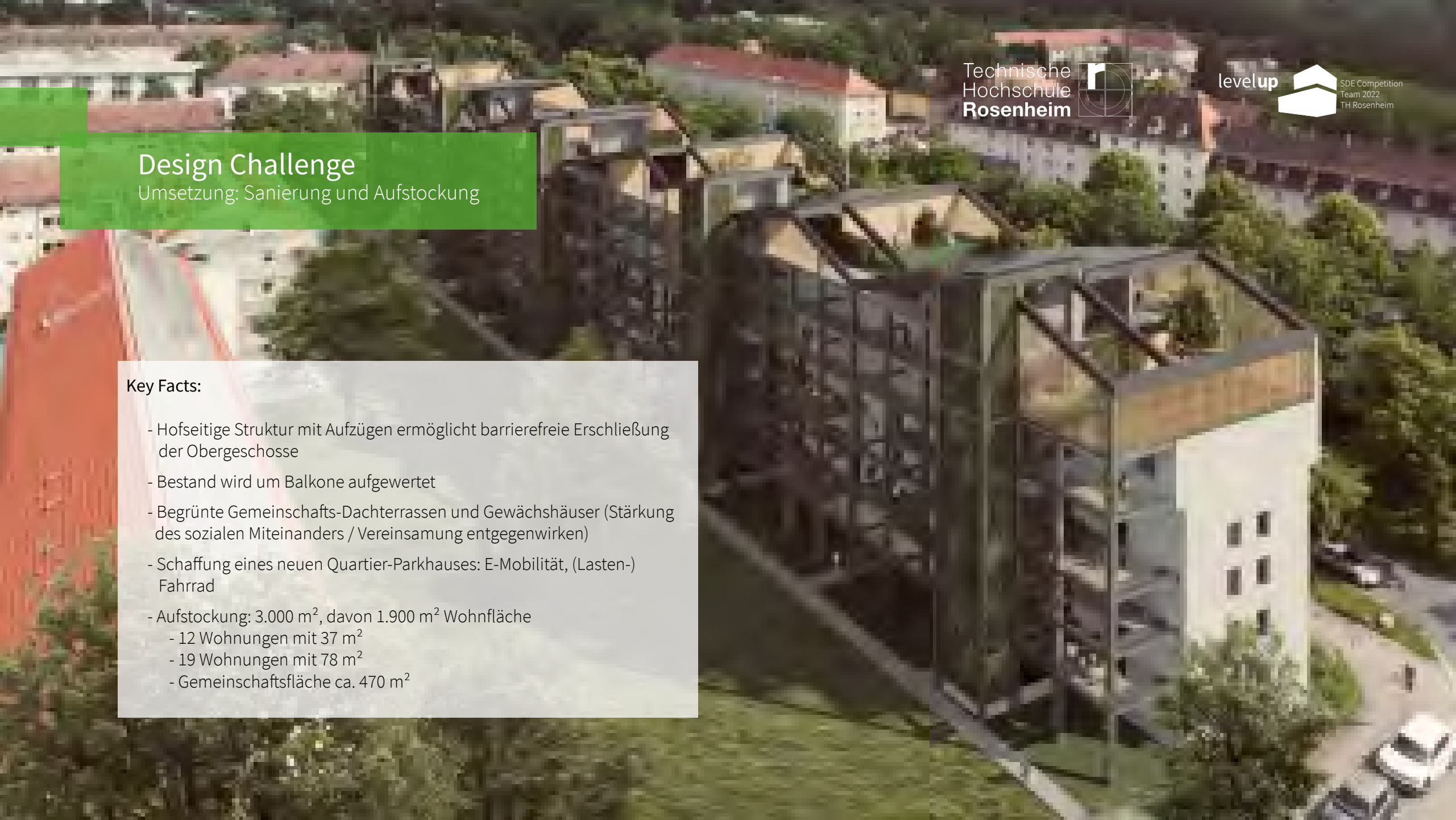
-Zweigeschossiger Holzmodulbau (serielles Bauen)

-31 neue barrierefreie Wohnungen

-Aneinandergereihte Satteldächer und neue Höhe des Gebäudes ermöglichen ein neues PV(T)-Potenzial

- BIPV an Bestandsfassade

-Fassadenheizung an Bestand (Bestandwohnungen werden grundkonditioniert) – Wärme aus PVT-Kollektoren und Rücklauf des örtlichen Fernwärmenetzes →Heizungen mit geringerer Vorlauftemperatur, dadurch werden größere Sanierungsmaßnahmen im Inneren der Wohnungen den Mietern erspart.



Technische Hochschule Rosenheim

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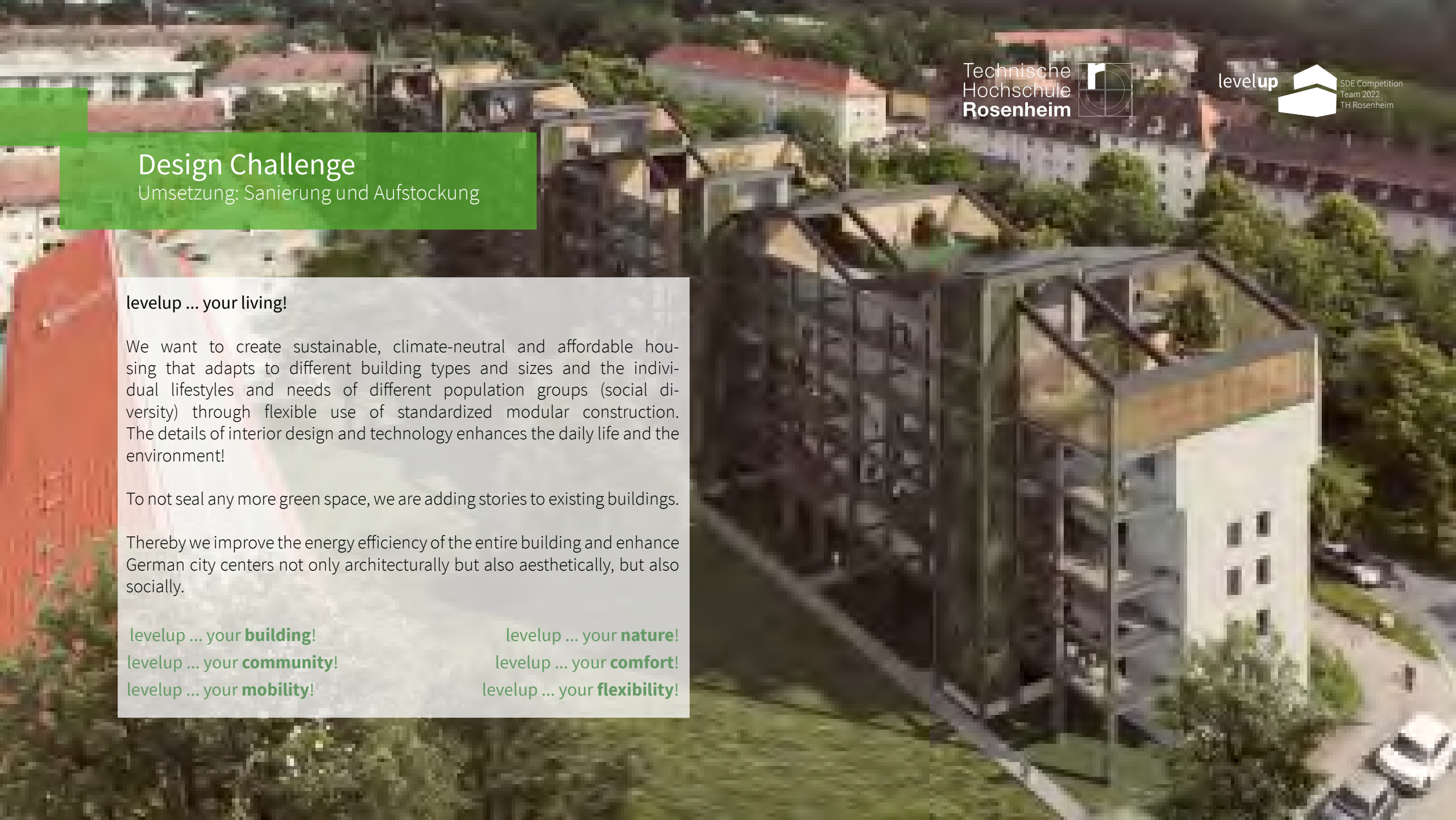
SDE Competition
Team 2022
TH Rosenheim

Design Challenge

Umsetzung: Sanierung und Aufstockung

Key Facts:

- Hofseitige Struktur mit Aufzügen ermöglicht barrierefreie Erschließung der Obergeschosse
- Bestand wird um Balkone aufgewertet
- Begrünte Gemeinschafts-Dachterrassen und Gewächshäuser (Stärkung des sozialen Miteinanders / Vereinsamung entgegenwirken)
- Schaffung eines neuen Quartier-Parkhauses: E-Mobilität, (Lasten-) Fahrrad
- Aufstockung: 3.000 m^2, davon 1.900 m^2 Wohnfläche
  - 12 Wohnungen mit 37 m^2
  - 19 Wohnungen mit 78 m^2
  - Gemeinschaftsfläche ca. 470 m^2



Technische Hochschule Rosenheim

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SDE Competition
Team 2022
TH Rosenheim

Design Challenge

Umsetzung: Sanierung und Aufstockung

levelup ... your living!

We want to create sustainable, climate-neutral and affordable housing that adapts to different building types and sizes and the individual lifestyles and needs of different population groups (social diversity) through flexible use of standardized modular construction. The details of interior design and technology enhances the daily life and the environment!

To not seal any more green space, we are adding stories to existing buildings.

Thereby we improve the energy efficiency of the entire building and enhance German city centers not only architecturally but also aesthetically, but also socially.

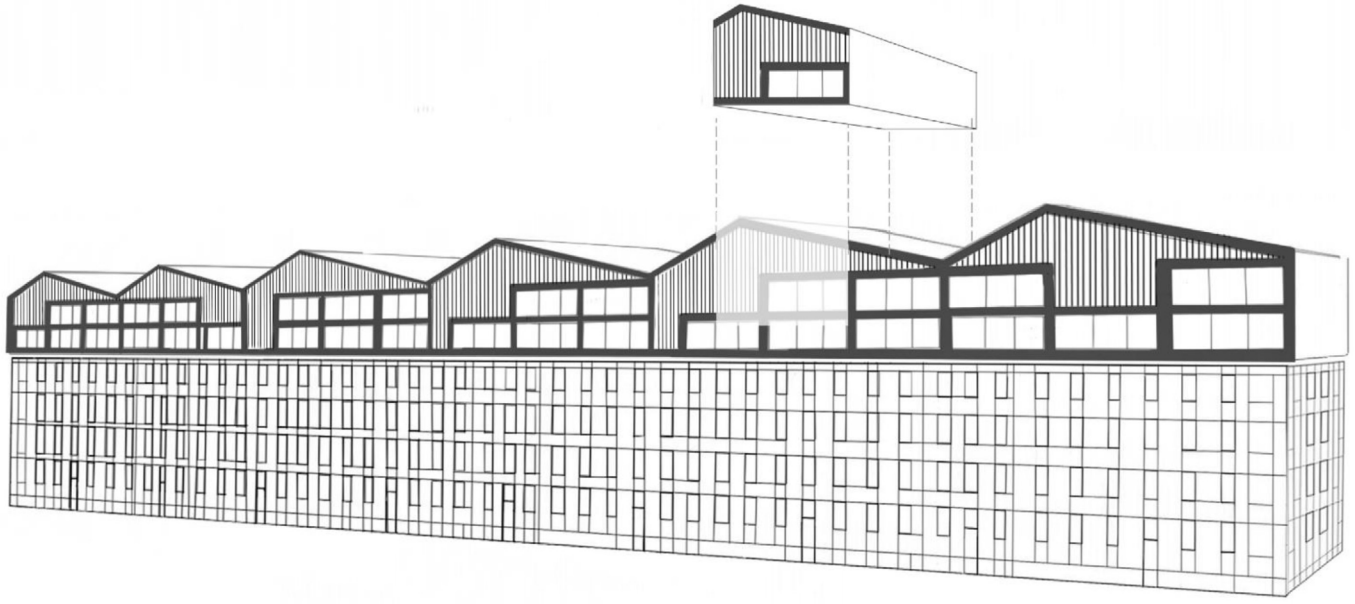
levelup ... your **building**!
levelup ... your **community**!
levelup ... your **mobility**!
levelup ... your **nature**!
levelup ... your **comfort**!
levelup ... your **flexibility**!

Design Challenge

Die Story | House Demonstration Unit

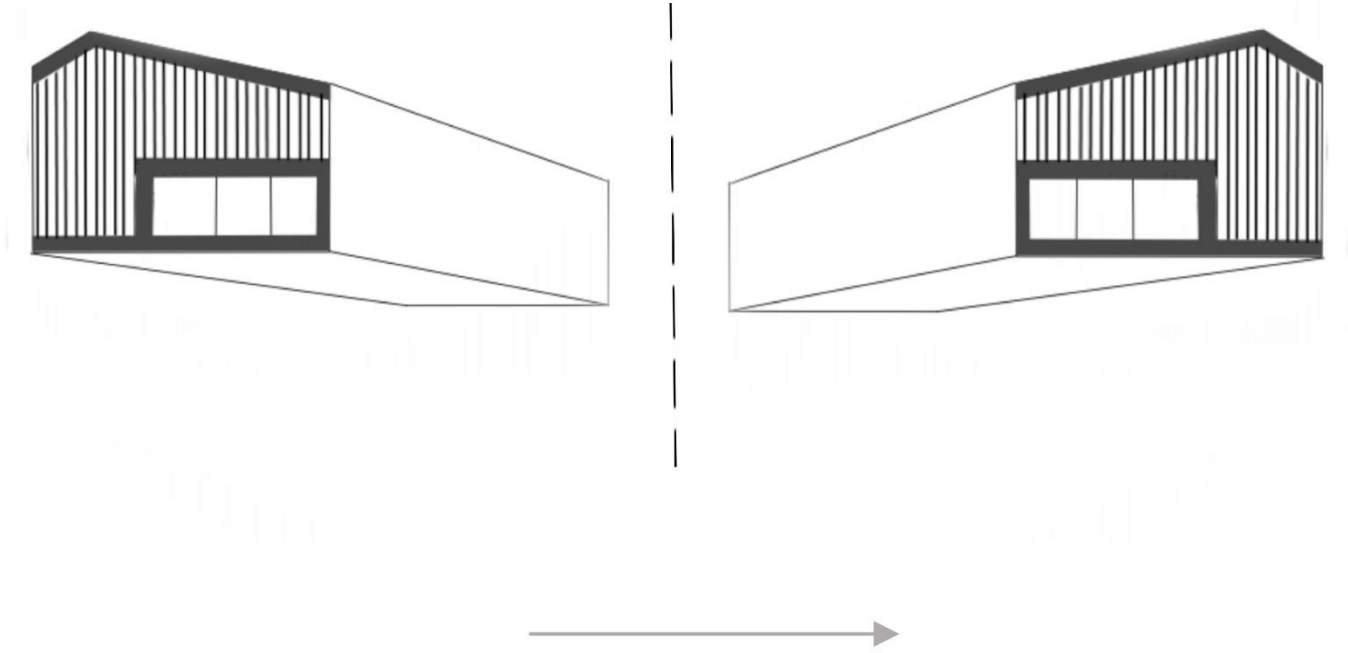
Building Challenge

Die Story | Auswahl einer repräsentativen Unit



Building Challenge

Die Story | Spiegelung der House Demonstration Unit



Building Challenge
House Demonstration Unit

Technische Hochschule **Rosenheim**

levelup

SDE Competition
Team 2022
TH Rosenheim

Technische Hochschule Rosenheim

levelup SDE Competition Team 2022 TH Rosenheim

Building Challenge

Aufbau der HDU am Campus der TH Rosenheim

Building Challenge

Aufbau der HDU am Campus der TH Rosenheim

Bautagebuch auf unserer Website: levelup-ro.de

Technische Hochschule Rosenheim

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Technische Hochschule Rosenheim

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Building Challenge

Richtfest mit der Staatsministerin für Wohnen, Bau und Verkehr Kerstin Schreyer

Projektleiter Andreas Boschert, TH-Präsident Prof. Heinrich Köster, Bayerns Bauministerin Kerstin Schreyer und stellvertretend für das studentische Team Sebastian Obermaier (von links) beim Richtfest an der levelup-Baustelle.

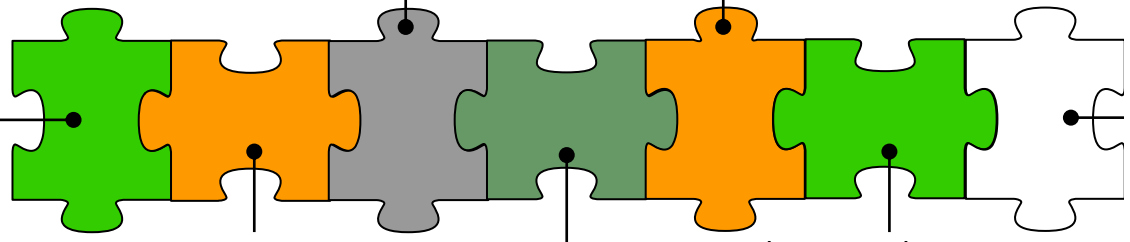
Ausblick

Meilensteine

bis April / Anfang Mai 2022
Aufbau der gesamten House Demonstration Unit (HDU) in Rosenheim inkl. Monitoring und Optimierung

20. Mai – 03. Juni
Aufbau der HDU in Wuppertal auf dem Solar Campus im Mirker Quartier

27. Juni – 03. Juli
Abbau der HDU auf dem Solar Campus und Wiederaufbau auf dem Campus der TH Rosenheim + Vorbereitung Nachnutzung

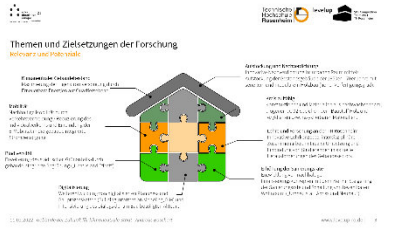


Mai 2022
Abbau der HDU in Rosenheim und Modul- Transport nach Wuppertal

10. – 26. Juni 2022
Wettbewerbsfinale
Solar Decathlon Europe 21/22

bis Dezember 2022
Projektdokumentation (z.B. Fachbuch)
+ Folgeanträge für weitere Forschungsprojekte (u.a. NaMaAn)

Zusammenfassung



Ausgangslage und Relevanz

- Alternder Gebäudebestand verursacht hohe CO2-Emissionen, zugleich geringe Sanierungsrate (1 %)
- Wohnraum im urbanen Raum Mangelware – Bundesweit fehlen 630.000 Wohnungen, davon mind. 80.000 Sozialwohnungen pro Jahr
- Flächenverbrauch / Versieglung nimmt stetig zu (51.000 km^2 pro Jahr)
- Klimaanpassung an steigende Temperaturen notwendig

Design Challenge

- Aufstockung in Holzmodulbauweise (serielles Bauen → Reduktion von Bauzeit und –kosten)
- Stärkung des sozialen Miteinanders eine zunehmend wichtige Komponente!
- 31 neue Wohnungen auf zwei Ebenen, inkl. Gemeinschaftsflächen (z.B. Dachgärten)
- Geringer Eingriff in das Bestandsgebäude (in die Wohnungen) durch beheizte Fassade
- Umfassender Einsatz erneuerbarer Energien (It‘s not Rocket Science!)

Building Challenge (House Demonstration Unit)

- Voll-funktionsfähiger Prototyp im Maßstab 1:1 - Ausschnitt der Aufstockung inkl. „angepasster“ Dachlandschaft
- Leimfreier Holzbau und Verwendung von nachhaltigen bzw. rezyklierten Materialien
- Umfangreiches Energie- und Gebäudetechnik-Konzept mit PVT, Wärmepumpe, Wärmerückgewinnung in Dusche, Gebäudeautomation, uvm.

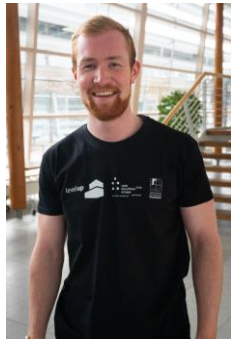
→ alle Informationen / Highlights folgen zum Wettbewerbsfinale in Wuppertal – **Neugierig?**

Ansprechpartner

Studentische Teamleiter*innen »levelup«

Julia Bachmaier
Communication, Education & Social Awareness

Giulia Bettini
Architecture, Interior Design & Sustainability



Michael Hobmaier
Energy and Building Technology

Marinus Limbrunner
Building Information Modeling (BIM)

Sebastian Obermaier
Energy and Building Technology

Julia Paternoster
Graphic & Design

Nadja Pollack
Architecture

Barbara Salzeder
Communication

Sabrina Sehnal
Affordability & Viability

Jakob Werner
Sponsoring

Tim Ziegler
Urban Mobility

Ansprechpartner

Leitung Team »levelup« der Technischen Hochschule Rosenheim

Prof. Dr. Jochen Stopper (Wissenschaftlicher Leiter)
Fakultät für Innenarchitektur, Architektur und Design (IAD) Telefon: +49 (0) 8031 805-2563
E-Mail: jochen.stopper@th-rosenheim.de

„Der Solar Decathlon verbindet gesellschaftliches Engagement mit fachlichem, theoretischem und praktischem Lernen!“

Andreas Boschert, M. Sc. (Projektleiter)
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E-Mail: andreas.boschert@th-rosenheim.de

Dipl.-Ing. (FH) Yona Schmälzle (Projektleiterin Bau)
Zentrum für Forschung, Entwicklung und Transfer
Telefon: +49 (0) 8031 805-2737
E-Mail: yona.schmaelzle@th-rosenheim.de

Kooperationen und Leistungen für Partner

Zusammenkommen ist ein Beginn, zusammenbleiben ist ein Fortschritt, zusammenarbeiten ist ein Erfolg (Henry Ford)

Das Projektteam »levelup« freut sich über Ihre Unterstützung. Jedes Engagement für das Projekt wird in einer schriftlichen Vereinbarung festgehalten.
Die Rahmenbedingungen können individuell vereinbart werden. Es ist uns wichtig im Verlauf des Projektes das Engagement jedes Unterstützers in besonderer wirksamer Weise zu würdigen, sodass sich die Projektbeteiligung auch für unsere Partner bezahlt macht. Der Wettbewerb stärkt und fördert den Technologie- und Innovationsstandort Bayern und bietet die Möglichkeit, das Know-how aus Deutschland interessierten Besuchern aus der ganzen Welt vorzustellen. Die Erfahrung hat gezeigt, dass eine sehr große Resonanz für ein Hochschulprojekt dieses Ausmaßes zu erwarten ist.

Mögliche Kooperationen

- **Klassische Spende: Sach-, Dienstleistungs- oder Geldspende (Spendenquittung möglich)**

  - ✓ PR für innovatives Bauen durch sehr großes Medieninteresse (Filme, Fachzeitschriften, Konferenzbeiträge, Website-Beiträge, Veranstaltungen, etc.)
  - ✓ langfristige Imageverbesserung
  - ✓ Positionierung als innovativer und zukunfts-orientierter Partner
  - ✓ Kontakt zu anderen Sponsoren, Partnern und Wissensträgern
  - ✓ Gemeinsame Entwicklung und kommerzielle Erprobung von Innovationen in Laboren und Instituten | Proof of Concept für Marktreife
  - ✓ Innovative Ideen und adaptierbare Konzepte (interdisziplinäre Teams aus Studenten und Professoren)
  - ✓ Teilhabe und Einflussnahme an der Projektentwicklung und ggf. darauf aufbauenden Forschungs- und Realisierungsprojekt
  - ✓ Direkten Kontakt zu Studierende (potenzielle Arbeitnehmer, zukünftige Fachkräfte)

Kooperationen und Leistungen für Partner

Zusammenkommen ist ein Beginn, zusammenbleiben ist ein Fortschritt, zusammenarbeiten ist ein Erfolg (Henry Ford)

	Vor…	Während…	und nach dem Wettbewerb
Online	• Firmenlogo auf Projekt-Website levelup-ro.de • Fachartikel		Fernsehbeiträge
Standort / Persönlich	• Interviews • Ausstellungen • Vorträge • Kontakt zu Studierende • Gemeinsamer Messe-Auftritt	• Product Placement • in der Ausstellung (geplant Augmented und Virtual Reality) • Ggf. Firmen-Ausstellung am Country & Culture Day	• Messen und Veranstaltungen • Umsetzung gemeinsamer (Bau)-Projekte • Beantragung von Forschungsprojekt
Print	• Fachartikel in Zeitschriften • Konferenz-beiträge • Publikationen • Press Kit und Press Release		Veröffentlichung von Büchern über: • Team levelup • Wettbewerb

Kooperationen und Leistungen für Partner

Jakob Werner
Sponsoring Manager - Team levelup Solar Decathlon Europe 21»22
Zentrum für Forschung, Entwicklung und Transfer
jakob.werner@th-rosenheim.de
Tel.: +49 162 5457900

Abb. 6: Modell der House Demonstration Unit im Maßstab 1:25. Gemeinsam mit dem Modell für die Design Challenge wurde unser Wettbewerbsbeitrag in Wuppertal über den Sommer hinweg ausgestellt.
Bildquelle: Stefan Guggenbichler, THRO

Gefördert durch
Bayerisches Staatsministerium für Wohnen, Bau und Verkehr

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages

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Facebook: https://www.facebook.com/leveluprosenheim
Instagram: https://www.instagram.com/levelup_ro/
YouTube: levelup Rosenheim

Have we sparked your interest and you would like to learn more?

Jochen Stopper

Scientific director and professor for energy-efficient and sustainable building

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Jakob Werner

sponsorship manager

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solar decathlon 21-22
WUPPERTAL GERMANY ...goes urban!

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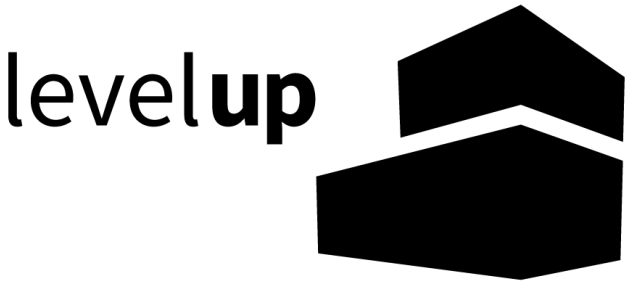
SDE Competition
TH Rosenheim
Handbuch

Team Visual Identity Manual D#6

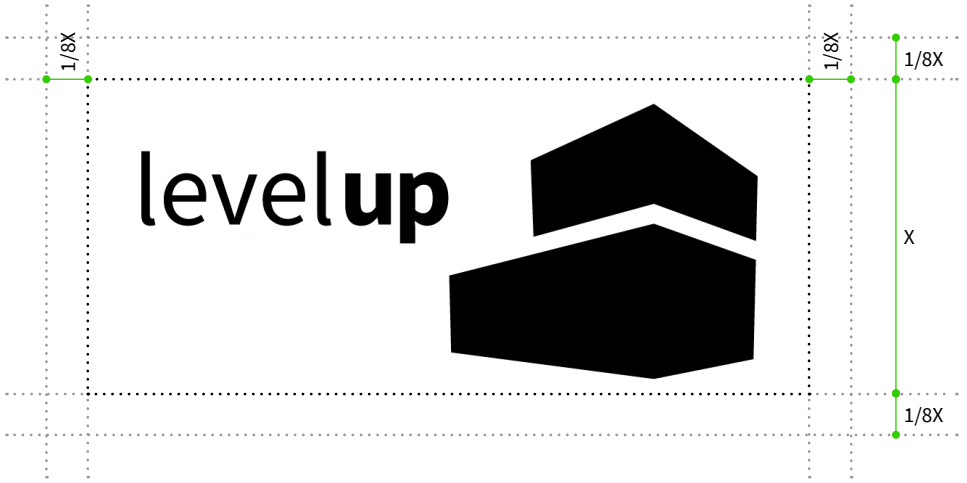
Inhaltsverzeichnis

Logo

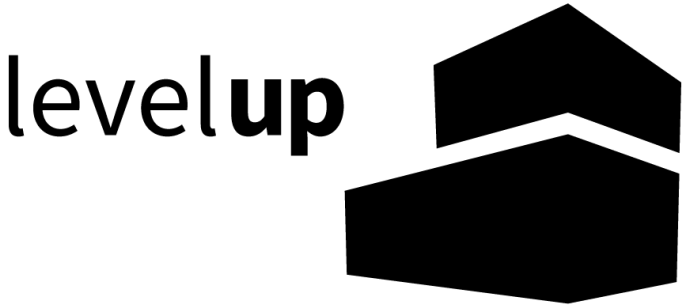
Variante alleinstehend



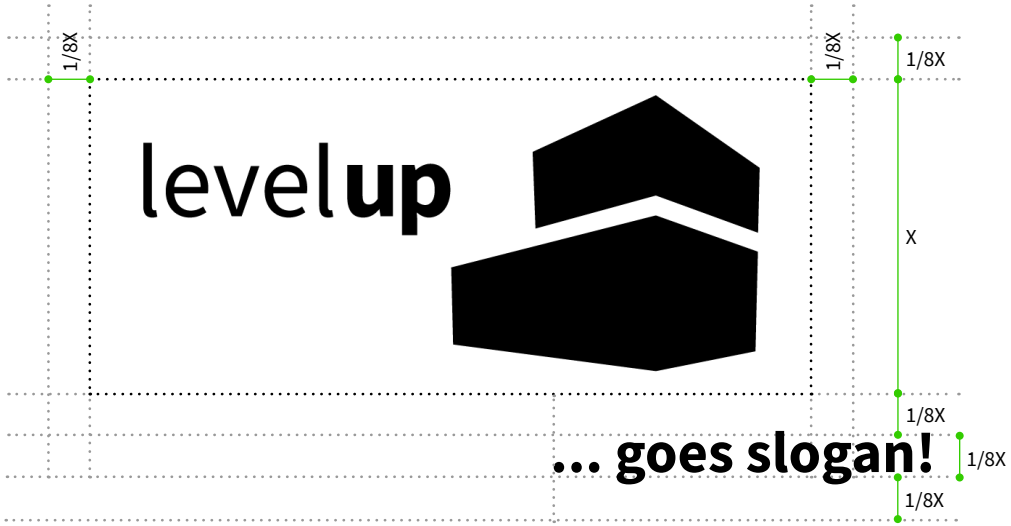
Abstand



Variante mit Schriftzug



Variante mit Slogan



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SPARKASSENSTIFTUNG ZUKUNFT
FÜR DEN LANDKREIS ROSENHEIM
SPARKASSENSTIFTUNG ZUKUNFT
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Spenglerei
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STEICO
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BERGISCHE UNIVERSITÄT WUPPERTAL

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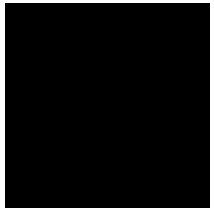
Farbwahl

Grundfarben



Coal

CMYK	20 | 0 | 0 |100
RGB	0 | 0 | 0
WEB	000000

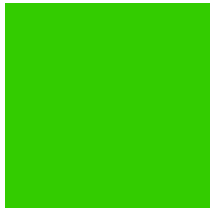
Grace

CMYK	0 | 0 | 0 | 40
RGB	153 | 153 | 153
WEB	999999

Olivia

CMYK	64 | 22 | 74 | 0
RGB	102 | 153 | 102
WEB	669966

Akzentfarben



Cordula

CMYK	70 | 0 | 100 | 0
RGB	51 | 204 | 0
WEB	33CC00

Orangina

CMYK	0 | 50 | 100 | 0
RGB	255 | 153 | 0
WEB	FF9900

Farbpaletten

Coal

CMYK	0 | 0 | 0 | 80
RGB	51 | 51 | 51
WEB	333333

CMYK	0 | 0 | 0 | 60
RGB	102 | 102 | 102
WEB	666666

Grace

CMYK	0 | 0 | 0 | 20
RGB	204 | 204 | 204
WEB	CCCCCC

Farbpaletten

Olivia

CMYK	31 | 0 | 31 | 65
RGB	61 | 89 | 61
WEB	3D593D

CMYK	33 | 0 | 33 | 50
RGB	85 | 127 | 85
WEB	557F55

CMYK	34 | 0 | 33 | 36
RGB	109 | 164 | 110
WEB	6DA46E

CMYK	24 | 0 | 29 | 18
RGB	158 | 209 | 148
WEB	9ED194

Farbpaletten

Cordula

CMYK	100 | 0 | 54 | 33
RGB	0 | 171 | 78
WEB	00AB4E

CMYK	33 | 0 | 33 | 50
RGB	80 | 184 | 72
WEB	50B848

CMYK	50 | 0 | 61 | 28
RGB	92 | 214 | 51
WEB	5CD633

CMYK	41 | 0 | 54 | 12
RGB	133 | 224 | 102
WEB	85E066

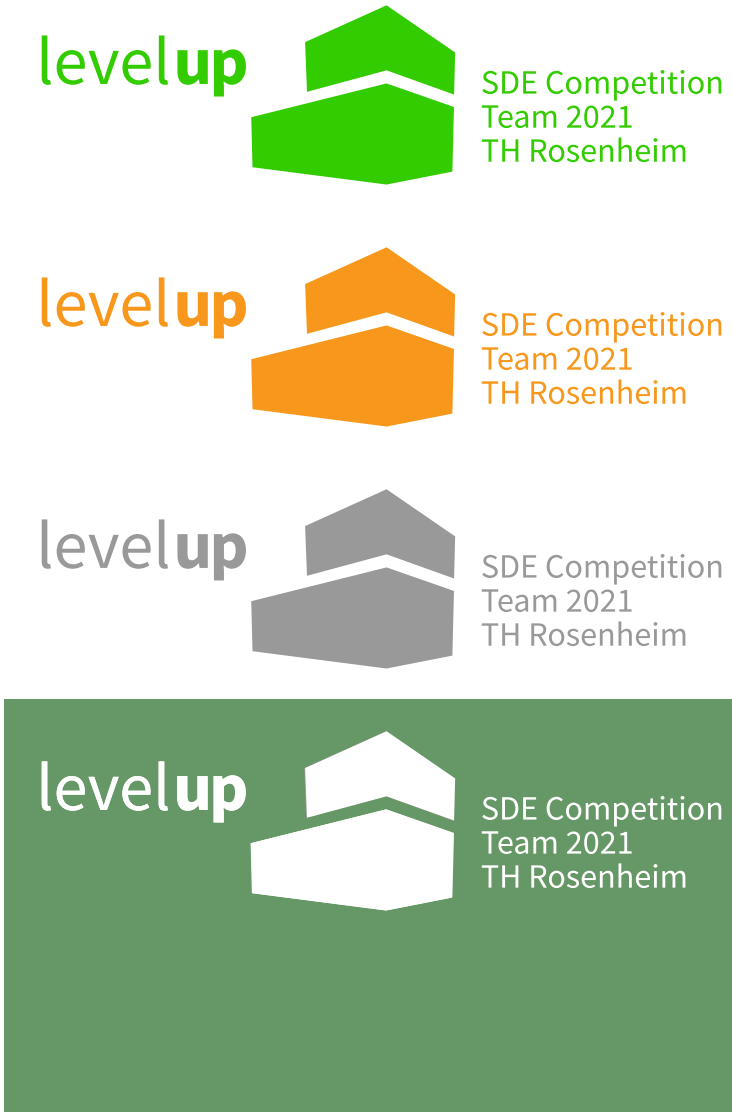
Farbpaletten

Orangina

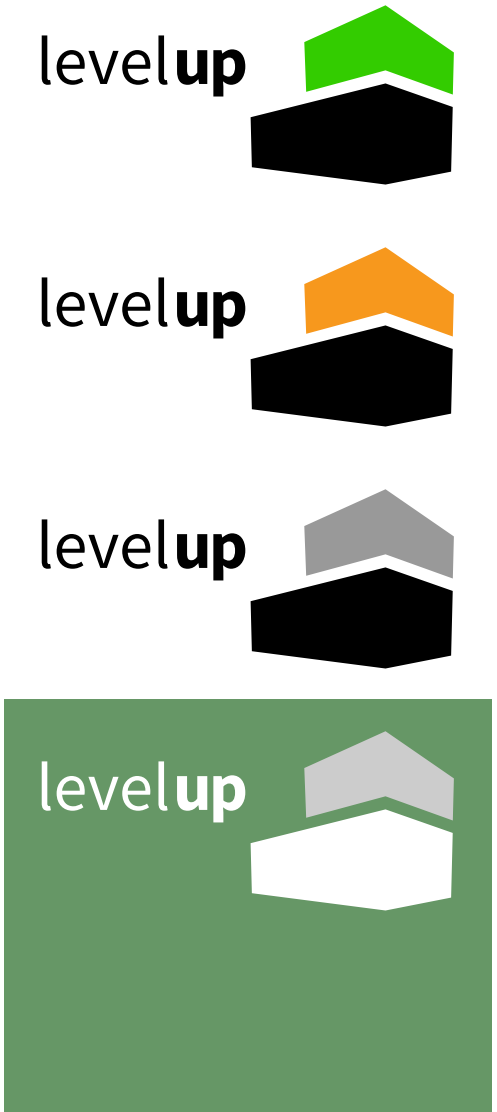
	CMYK	0 | 58 | 84 | 5
	RGB	242 | 101 | 38
	WEB	F26526
	CMYK	0 | 47 | 87 | 4
	RGB	245 | 130 | 32
	WEB	F58220
	CMYK	0 | 29 | 79 | 4
	RGB	255 | 173 | 51
	WEB	FFAD33
	CMYK	0 | 24 | 60 | 0
	RGB	255 | 193 | 102
	WEB	FFC166

Farbanwendungen am Logo

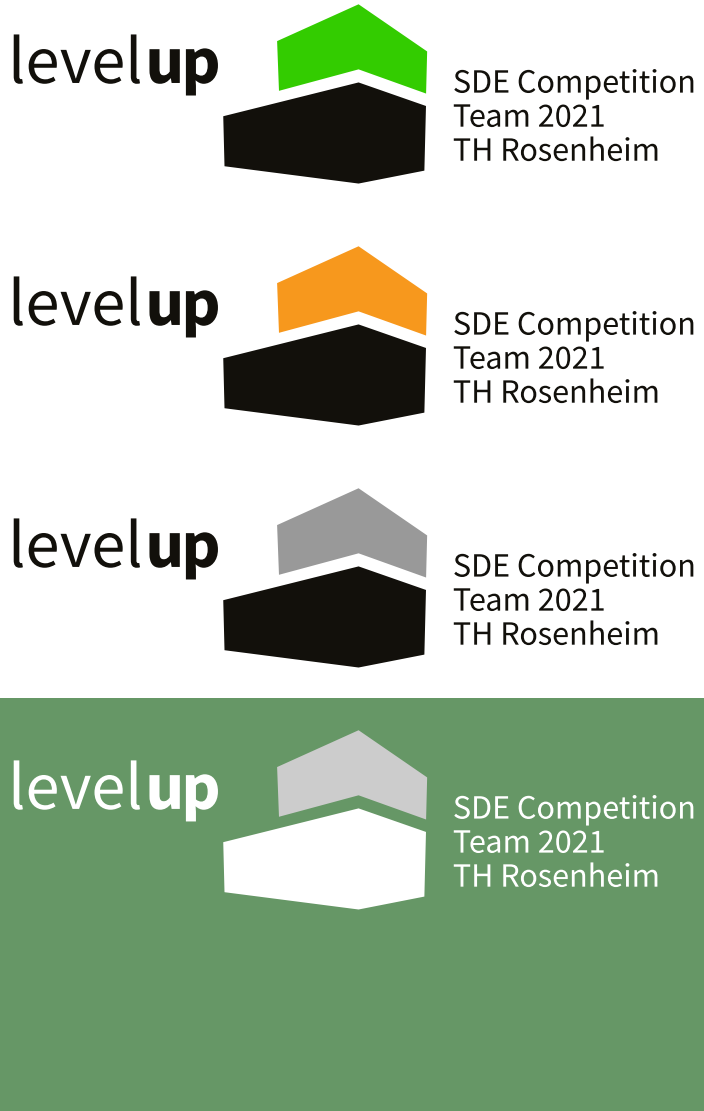
Farbanwendungen am Logo



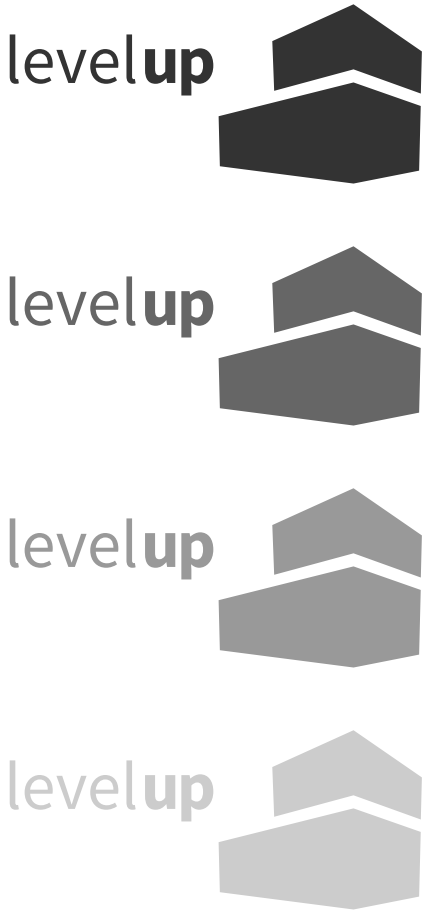
Farbanwendungen am Logo



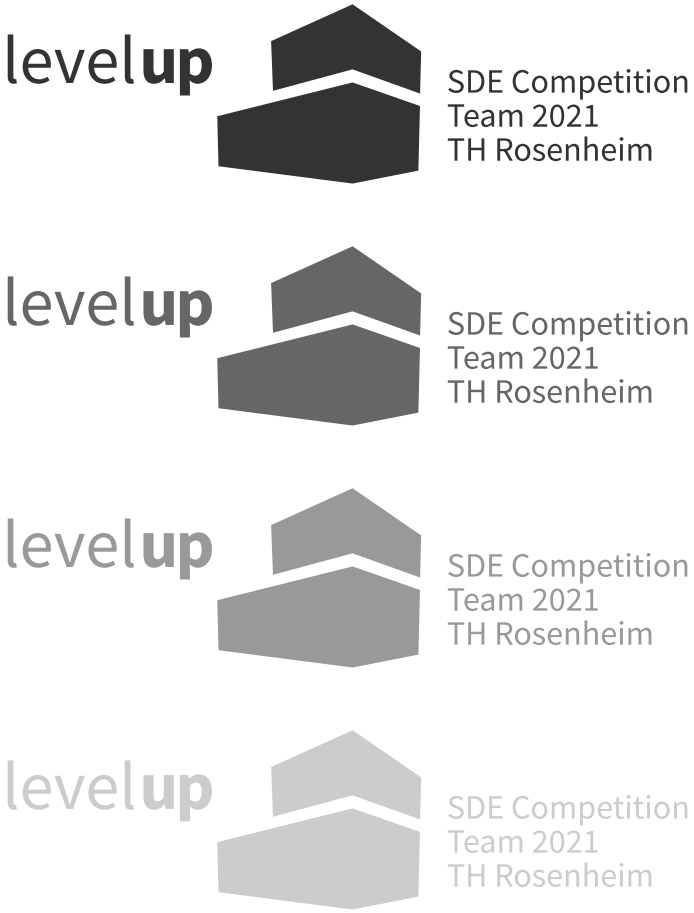
Farbanwendungen am Logo



Farbanwendungen am Logo, in Graustufen



Farbanwendungen am Logo, in Graustufen



Typografie

Source Sans Pro

Source Sans Pro 20Pt Light
Source Sans Pro 20Pt Regular
Source Sans Pro 20Pt Bold

A B C D E F G H I J K L M N
O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n
o p q r s t u v w x y z
(Regular)

The **quick brown fox** jumps over the **lazy dog.** (8 Pt)
The **quick brown fox** jumps over the **lazy dog.** (10 Pt)
The **quick brown fox** jumps over the **lazy dog.** (12 Pt)
The **quick brown fox** jumps over the **lazy dog.** (14 Pt)
*The **quick brown fox** jumps over the **lazy dog.** (14 Pt kursiv)*

Überschriften
(von ... Pt bis ...Pt, Source Sans Pro Bold)

Fließtext ... Rehendam quas aut veliquatem. Itates doluptur, tem.Equatur, que aspideb isciae nectia volecabore opta quo estrum de evel magnam si tor moluptas prae sum exero dolut pos dolore volor sam, eum et parchil luptusam, suntiunte comnihic temperum corum aditatet lab il ipictassequi nis res dis el is ut ut iuntio. Nam faccuptum illit quas excearum et haris ea deles quodita temoditiatur ad moluptio bearumquis ad eicides quam evelici atecerfero vid enderrorest, suntiunto beatiat.

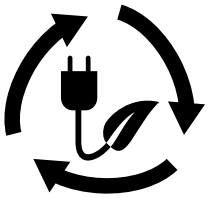
Perecte est, ad quodia id mil ilique dunde latur, sim comnis id mod mo conseque volupti dolorem ut utaepuditati vendipsam volupta porit et magnatum que elestrunt fuga. Et quam quia si dolestrum lab inciatisquae nis maio essectiones id quam, qui nonsendiciur sitectia dolo esciam quoditibus accus. (von ... Pt bis ... Pt, Source Sans Pro Light)

Bildunterschriften
(von ... Pt bis ... Pt, Source Sans Pro Light)

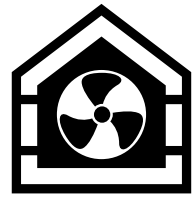
Piktogramme

our vision:
levelup ...

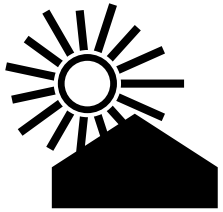
... your building



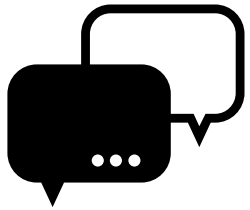
... your sustainability



... your comfort



... your technology



... your community

Team Uniforms

T-Shirts mit umlaufender Gipfelkette

Team Uniforms

levelup

Public tour

[redacted]

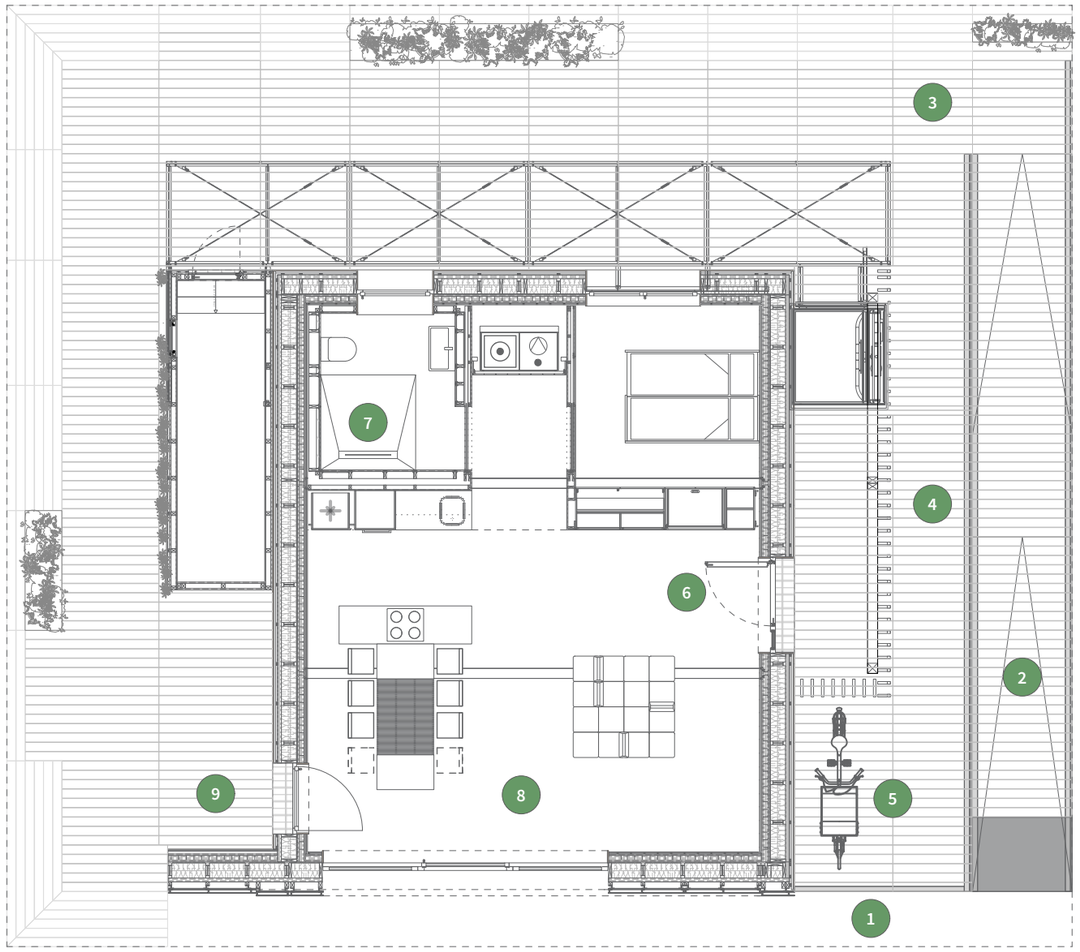
Station	Topic	Implementation of information	Additional entertainment for the educational target group
OUTSIDE and START			
1. Check-in	[redacted]	[redacted]	[redacted]
2. Insights of levelup concept "levelup to go"	[redacted]	[redacted]	[redacted]
3. Modular construction	[redacted]	[redacted]	
4. Sustainability / innovation	[redacted]	[redacted]	[redacted]
5. Cargo bike	[redacted]	[redacted]	[redacted]
INSIDE			
6. Modularization of the rooms	[redacted]	[redacted]	[redacted]
7. Interior design of kitchen, living, work	[redacted]	[redacted]	[redacted]
8. Bathroom	[redacted]	[redacted]	[redacted]

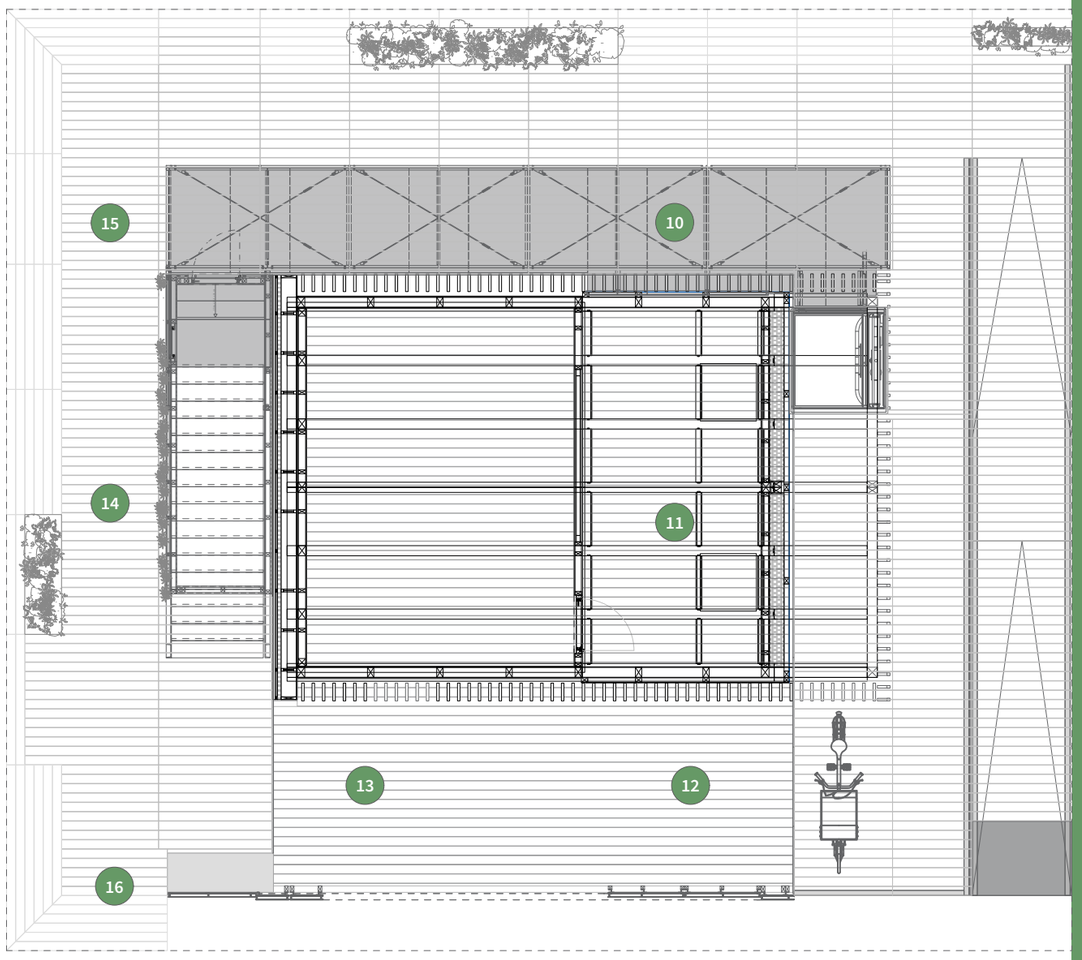
9. lighting, windows and shading	[illegible]	- [illegible] - [illegible]	
10. Facade	[illegible]	-[illegible] -[illegible]	
TOP and END			
11. greening / common areas	[illegible]	-[illegible] -[illegible] -[illegible]	-[illegible] -[illegible]
12. Sustainability and solar energy	[illegible]	-[illegible] -[illegible]	-[illegible] -[illegible]
13. Bar, lounge and viewing point	[illegible]	-[illegible] -[illegible]	-[illegible] -[illegible] -[illegible] -[illegible] -[illegible]
14. Urban mobility and social community with sharing app	[illegible]	-[illegible] -[illegible]	-[illegible] -[illegible]
15. Energy/technology room	[illegible]	-[illegible] -[illegible]	
16. Infiltration ditch (as a sub-theme of the technical room)	[illegible]	-[illegible]	-[illegible]
17. Check-Out	[illegible]	-[illegible]	-[illegible]

OUTSIDE and START
1. Check-In
2. Insights of levelup
3. Modular construction
4. Sustainability / innovation
5. Cargo bike

INSIDE
6. Modularisation of the rooms
7. Bathroom
8. interior design of kitchen, living, work (incl. lighting)
9. Facade

TOP and END
10. greening / common areas
11. Sustainability and solar energy
12. Bar, lounge and viewing point
13. Urban mobility and social community with sharing app
14. Energy/technology room
15. infiltration ditch (as a sub-theme of the technical room)
16. Check-Out





levelup

solar decathlon europe 21
WUPPERTAL GERMANY ...goes urban!

General	GE
Architecture	AR
Interiors	IN
Structural	ST
Plumbing	PL
Solar Water Heating	SW
Mechanical	ME
Electrical	EL
Photovoltaic System	PV
Teleco. & Build. Aut. System	BAS
Instrumentation Drawings	ID
Site Operations	SO
Fire Protection	FP
Healthy & Safety	HS
Public Tour	**PT**

0 1,3 2,5 3,8 5

Scale
1:100 (A3 420 x 297)

Phase
D#6

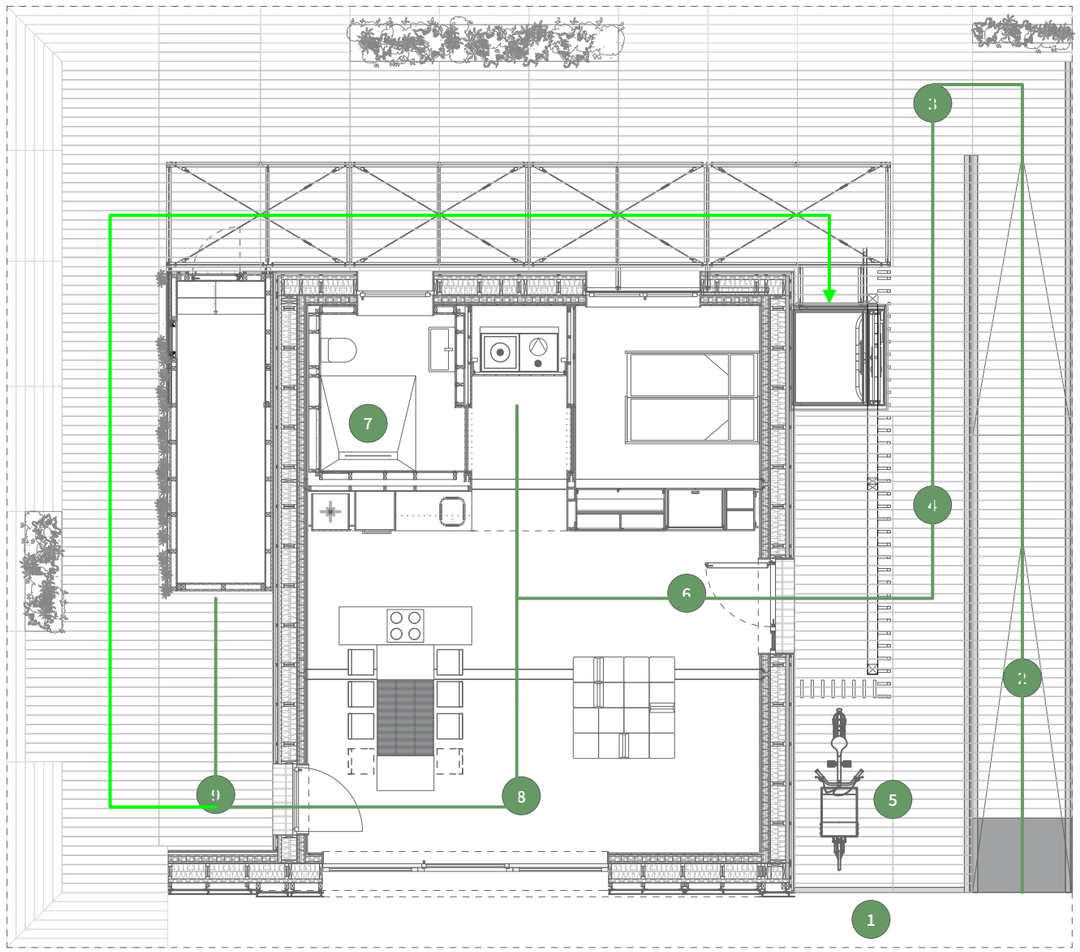
Drawing Content - HDU
Site accessibility

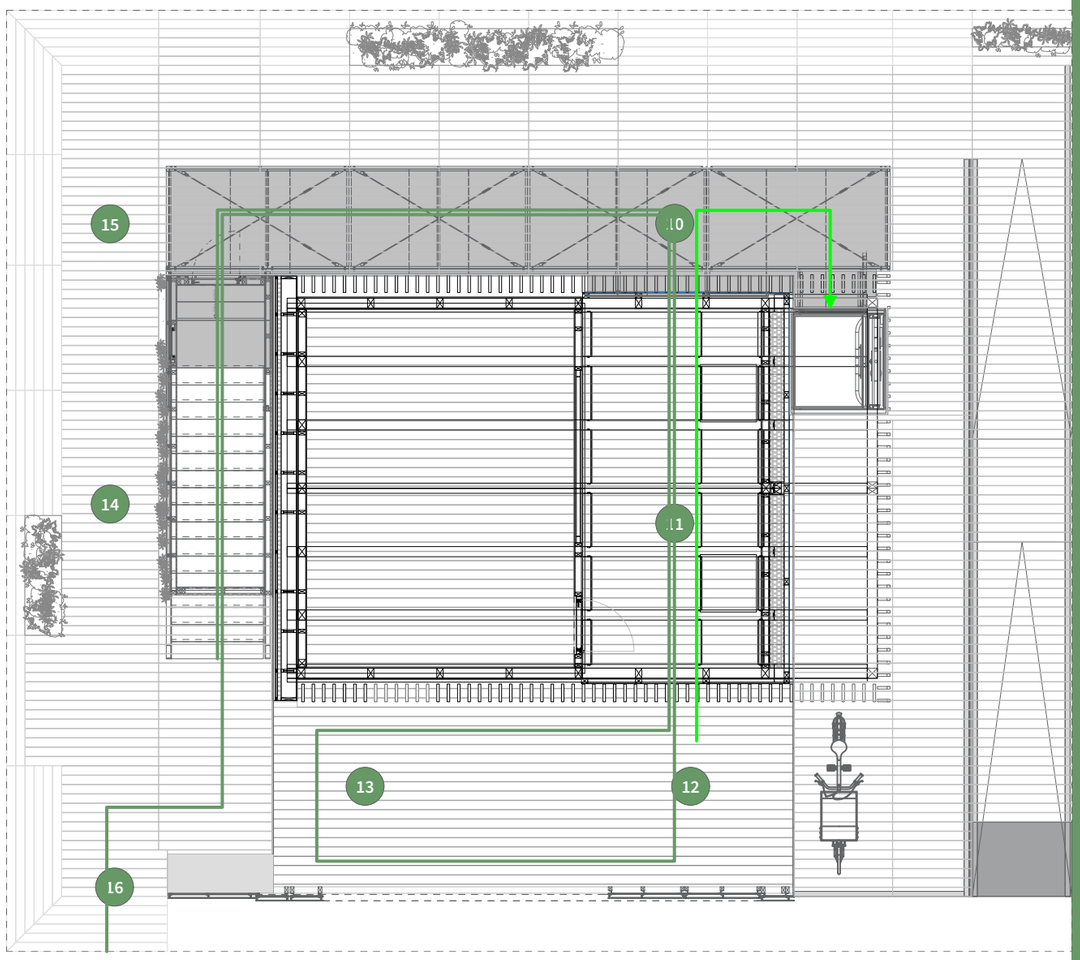
PT-0001

OUTSIDE and START
1. Check-In
2. Insights of levelup
3. Modular construction
4. Sustainability / innovation
5. Cargo bike

INSIDE
6. Modularisation of the rooms
7. Bathroom
8. interior design of kitchen, living, work (incl. lighting)
9. Facade

TOP and END
10. greening / common areas
11. Sustainability and solar energy
12. Bar, lounge and viewing point
13. Urban mobility and social community with sharing app
14. Energy/technology room
15. infiltration ditch (as a sub-theme of the technical room)
16. Check-Out





levelup

solar decathlon europe 21
WUPPERTAL GERMANY ...goes urban!

General	GE
Architecture	AR
Interiors	IN
Structural	ST
Plumbing	PL
Solar Water Heating	SW
Mechanical	ME
Electrical	EL
Photovoltaic System	PV
Teleco. & Build. Aut. System	BAS
Instrumentation Drawings	ID
Site Operations	SO
Fire Protection	FP
Healthy & Safety	HS
Public Tour	**PT**

0 1,3 2,5 3,8 5

Lift and barrier-free access

Scale
1:100 (A3 420 x 297)

Phase
D#6

Drawing Content - HDU
House Tour Floor Plan

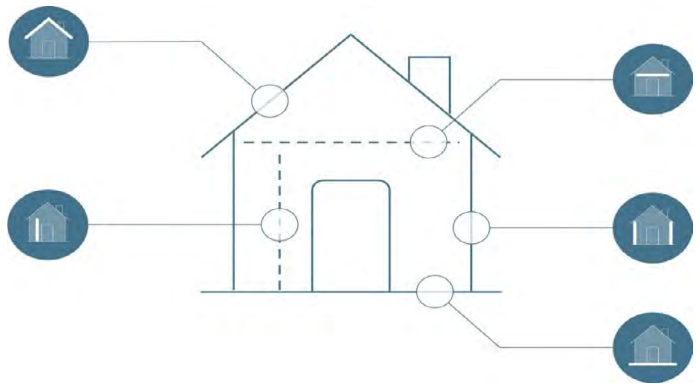
PT-1001

05 Appendix

Sustainability Report

RESULTS

COMPONENTS



PROJECT INFORMATION

TEAM ID

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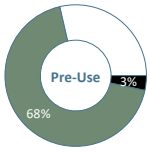
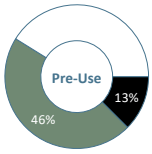
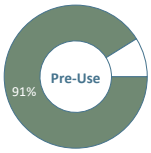
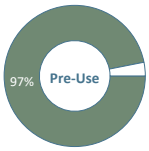
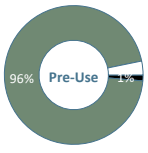
CLOSED-LOOP POTENTIAL

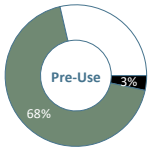
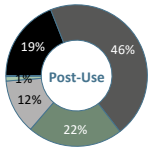



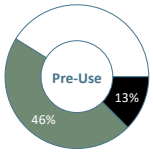
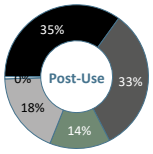



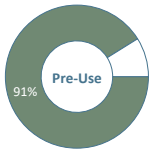
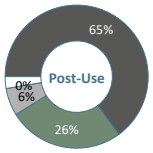



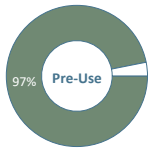
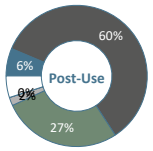



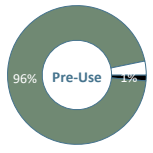
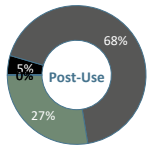
LOOP POTENTIAL

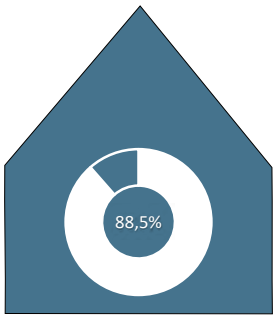



URBAN MINING INDICATOR



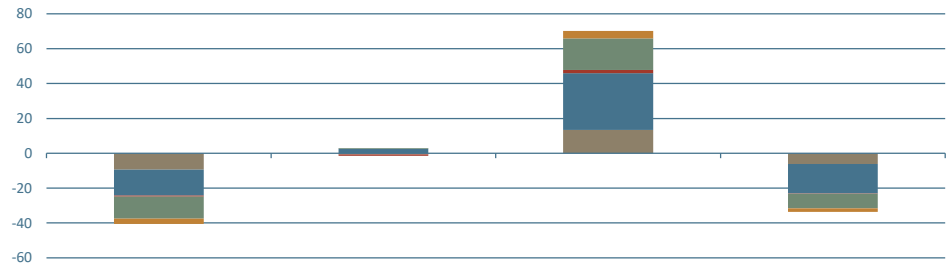
PRE-USE

- wiederverwendete Materialien (RU)
- wiederverwertete Materialien (RC)
- erneuerbare Primärrrohstoffe (RN)
- weiterverwertete Materialien (DC)
- Primärrohstoffe nicht erneuerbar (PR)

POST-USE

- wiederverwendbar (ru)
- wiederverwertbar (rc)
- weiterverwertbar, zert. nachhaltig nachwachsend (dccr)
- energ. verwertbar, zert.nachhaltig nachwachsend (encr)
- weiterverwertbar (dc)
- energetisch verwertbar nachwachsend (enr)
- energetisch verwerbar, fossil (enf) oder Entsorgung/Deponierung (w)

GLOBAL WARMING POTENTIAL

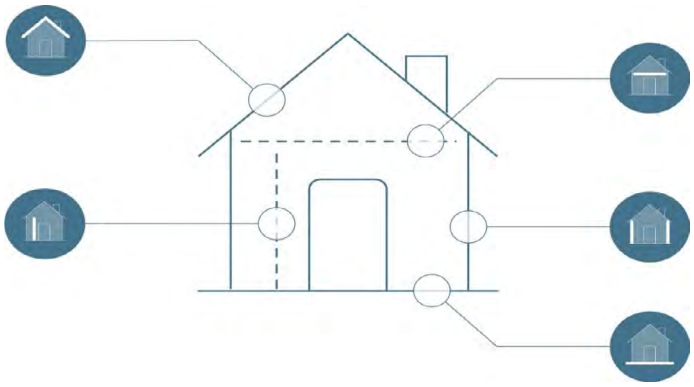


	Herstellung (A1-3)	Austausch (B4)	Entsorgung (C3-4)	Vorteile außerhalb Systemgrenze (D)
TOTAL [t CO_2-eq.]	-41	2	70	-34

GWP	TOTAL
Gründungen	-2,7
Außenwände	3,4
Innenwände	0,0
Decken	-2,2
Dächer	-1,0
[t CO_2-eq.]	-2,4
Bezugsfläche	62,7 m^2
Bezugszeit	50 a
kg CO_2-eq-/m^2 p.a.	-0,8

RESULTS

COMPONENTS



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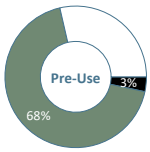
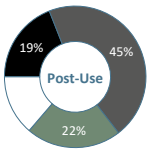
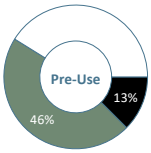
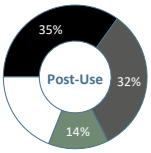
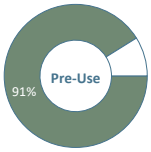
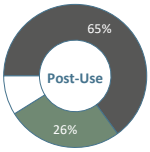


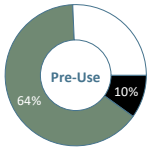


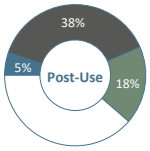



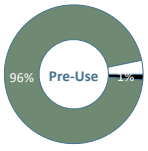


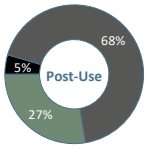





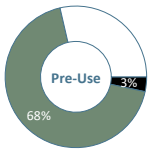



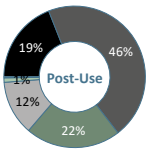


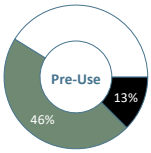



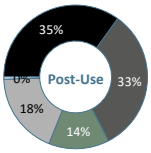


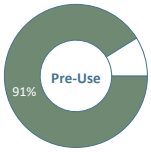
LOOP POTENTIAL

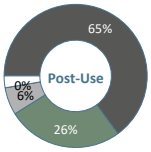


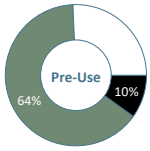


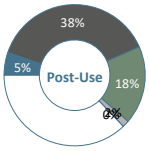


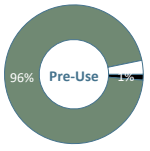


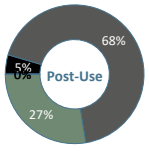




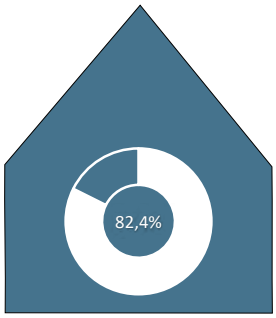








URBAN MINING INDICATOR



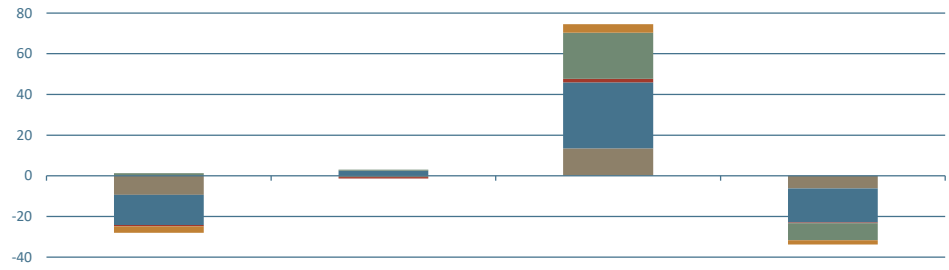
PRE-USE

- wiederverwendete Materialien (RU)
- wiederverwertete Materialien (RC)
- erneuerbare Primärrrohstoffe (RN)
- weiterverwertete Materialien (DC)
- Primärrohstoffe nicht erneuerbar (PR)

POST-USE

- wiederverwendbar (ru)
- wiederverwertbar (rc)
- weiterverwertbar, zert. nachhaltig nachwachsend (dccr)
- energ. verwertbar, zert.nachhaltig nachwachsend (encr)
- weiterverwertbar (dc)
- energetisch verwertbar nachwachsend (enr)
- energetisch verwerbar, fossil (enf) oder Entsorgung/Deponierung (w)

GLOBAL WARMING POTENTIAL



	Herstellung (A1-3)	Austausch (B4)	Entsorgung (C3-4)	Vorteile außerhalb Systemgrenze (D)
TOTAL [t CO_2-eq.]	-27	2	74	-34

GWP	TOTAL
Gründungen	-2,7
Außenwände	3,4
Innenwände	0,0
Decken	15,9
Dächer	-1,0
[t CO_2-eq.]	15,7
Bezugsfläche	62,7 m^2
Bezugszeit	50 a
kg CO_2-eq-/m^2 p.a.	5,0

06 Appendix

Urban Mobility Report

Docker

Docker is an open source for containerizing and deploying software, it is one of the largest opensource projects in the world. The entire infrastructure of our project runs in this virtual environment. This allows the project to be scaled and deployed on a target system (data centre) without much effort. It also guarantees that later development teams can run a development environment on their systems and work on them in a sustainable and time efficient way.

Docker Containerization

Containerization is comparable to a virtual machine, but offers considerable advantages. A virtual machine needs to simulate the entire operating system (i.e., Ubuntu running parallel on a Windows computer), which is very computationally intensive and costly. Containerization on the other hand is a lean and easy way of implementing virtualization, because it no longer completely simulates a new operating system, but only key components that are needed to run programs. This can be guaranteed to run on any machine where Docker operation is possible, which gives the program an agile advantage over conventional installations.

Keycloak

Key cloak is an opensource software product that enables single sign-on with identity and access management for modern applications and services. It is responsible for the user administration, authentication, and authorization management of our software. As an independent service, it is hosted in its own Docker container. Our backend (Spring Boot) can get information about the logged-in user from the Keycloak service, ask whether they are authorized to perform certain actions and forward users who are not logged in to the Keycloak login page. By outsourcing the user administration, the service can be used by several other services. Users therefore only need one user account for several applications.

Angular

Angular is a TypeScript-based front-end web application framework. Led by Google, it is developed by a community of individuals and companies and published as opensource software. Angular is geared towards web development for enterprise applications. The high modularity of Angular enables a clear design of the project. This means that large projects and further development by new developers are also possible. For authentication, our app uses the SSO-Service Keycloak.

Single page web application

Angular enables us to implement a single-page web application (SPA). Instead of requesting a new HTML document from the server when changing to another page of the application or when changing data on the page, the entire application is managed here on one page. Content can be dynamically reloaded and adapted on the page in real time. This not only increases the speed of the page, but also enables the departure of star HTML pages towards dynamic, moving, and adaptable applications. The difference between website and smartphone application is no longer there for the end user with tools such as PWA / TWA in combination with Angular

Spring Boot

Spring Boot is a Java dependency injection framework aimed at professional web development. By making it available as opensource software it is constantly being developed further and offers a wide range of functions.

REST Service

The backend of our application is responsible for receiving and responding to requests for data from the frontend (Angular) and for receiving and storing new data. These requests are sent to the backend in the form of REST http requests (GET, POST, PUT, etc.). To be able to establish this connection between frontend and backend, we use Spring Boot REST services.

Hibernate

Additionally, Spring Boot uses Hibernate to facilitate database access and management. In our case a ProstgeSQL database running in its own Docker container.

Spring Security

Spring Security, in collaboration with Keycloak, manages access permissions in our backend. The user sends a JWT (JSON Web Token) with their request, which is used by Spring Boot Security to query the user‘s identity and permissions from the Keycloak service. If identity or authorization is missing, request is rejected.

Progressive Web-App (PWA)

Progressive Web Apps (PWA) are a web-based, cross-platform application models. This type of application is developed exactly based on modern web technologies, which can not only be executed in the common web browsers, but also installed on various mobile and desktop operating systems. Progressive Web Apps can be created like a web page using HTML5, CSS3 and JavaScript. In addition, so-called service workers serve the offline functionalities through optimized caching. For communication between web client and web server, the HTTPS protocol is mandatory.

Continuous Integration / Continuous Deployment

With Continuous Integration (CI) code quality and code security is automatically checked and enforced by executing tests and analysis. The CI-Pipeline defines which tests and analysis should be run at a given event. The Continuous Deployment (CD) is responsible for automatically build and deploy certain parts of the software. Depending on the changes and events the CD-Pipeline builds a specified project like our Angular Single-Page-Application and deploys it on a given destination. In our case, the CI-Pipeline builds the applications to check if they can be executed, executes linting tests to ensure code quality and best practice and runs software tests to find bugs in previously functioning code. Our CD-Pipeline generates Docker images with our applications and uploads them to our Docker registry. Those uploaded images can then be deployed to the desired destination.

Appendix_1_User_Stories

ID	Title	Epic	Prioriti-sation	Description	User Story „As [role] I would like to [function] to [use].“
1	Add Vehicle	Administration	3. Release	The administrator must be able to add new vehicles to the fleet via the app.	--
2	Add news	Administration	MVP	The administrator must be able to manage and add the news displayed in the app.	As an administrator, I would like to be able to create new news in the app to inform the user about current activities.
3	Add events	Administration	MVP	The administrator must be able to manage and add the events displayed in the app.	As an administrator, I would like to be able to create new events in the app to inform the user about current events.
4	Manage user data	Administration	MVP	The user data such as name, contact data etc. must be editable by the administrator in the app. The data of the users or their entire profile can also be deleted by the administrator.	As an administrator, I would like to be able to manage user data in the app in order to be able to quickly and easily correct or adjust user data if desired, should the data change.
5	Create new user	Administration	MVP	The administrator should be able to create a new user with all necessary user data. This step precedes the feature "Send code for first login". When creating the user, the administrator must check whether the user is 16 years old. If the user is younger than 16, he cannot be created. Each user receives an ID consisting of the flat number (e.g. second floor 3 flat = 0203) and an ascending number for each additional user created in the flat. (3rd user within the flat gets the ID 02033)	As an administrator, I would like to be able to create new users so that new tenants or tenants who have become old enough to use the app can also access the app's services.

07 Appendix

Detailed Water Budget

Water consumption [l]

			25.05.2022	03.06.2022	13.06.2021	14.06.2021	15.06.2021	16.06.2021	17.06.2021	18.06.2021	19.06.2021	20.06.2021	21.06.2021	22.06.2021	27.06.2022
	Water delivery		8 - 11 a.m.	14 - 17 p.m.					9 - 12 a.m.						
Total water tapping	Washing machine	Process water			48	48	48	48	x	x	x	x	48	48	
	Dishwashing machine	Fresh water			9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	
	Cooking	Fresh water			3	3	3	3	x	x	x	3	3	3	
	Hot water drawing	Fresh water			150	150	150	100	50	50	50	150	150	100	
	Σ		x	x	210,5	210,5	210,5	260,5	59,5	59,5	59,5	210,5	210,5	160,5	x
Demand Process water	Washing machine		x	x	(48)	48	48	48	x	x	x	48	48	48	x
Demand Fresh water	Washing machine				48	x	x	x	x	x	x	x	x	x	
	Dishwashing machine				9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	
	Cooking				3	3	3	3	x	x	x	3	3	3	
	Hot water drawing				150	150	150	100	50	50	50	150	150	100	
	Σ		x	x	210,5	162,5	162,5	112,5	59,5	59,5	59,5	162,5	162,5	112,5	x
	water removal			14 - 17 p.m					9 - 12 a.m.						
Total waste water	Washing machine	Waste water			48	48	48	48	x	x	x	48	48	48	
	Dishwashing machine	Waste water			9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	
	Cooking	Waste water			1	1	1	1	x	x	x	1	1	1	
	Hot water drawing	Grey water			150	150	150	100	50	50	50	150	150	100	
	Dinner Party	Waste water			x	5	5	x	x	x	x	x	5	x	
	Σ		x	x	208,5	213,5	213,5	158,5	59,5	59,5	59,5	208,5	213,5	158,5	x
Grey water generation	Hot water drawing		x	x	150	150	150	100	50	50	50	150	150	100	x
Waste water generation	Washing machine				48	48	48	48	x	x	x	48	48	48	
	Dishwashing machine				9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	
	Cooking				1	1	1	1	1	1	1	1	1	1	
	Dinner Party				x	5	5	x	x	x	x	x	5	x	
	Σ		x	x	58,5	63,5	63,5	58,5	10,5	10,5	10,5	58,5	63,5	58,5	x

Tank capacity	Fresh water				210,5	373	535,5	648	707,5	59,5	119	281,5	444	556,5	
	Grey water				150	252	354	406	456	506	556	658	760	812	
	Waste water				58,5	122	185,5	244	254,5	10,5	21	79,5	143	201,5	

08 Appendix

Structural Calculations

levelup

energy endeavour FOUNDATION

Gefördert durch
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BERGISCHE UNIVERSITÄT WUPPERTAL

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