



# SCENARIO STUDY



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## ABOUT THE SCENARIO STUDY

In the context of the SUSKULT scenario study, the backcasting method was used to show the possible development paths from the SUSKULT target vision in 2050 back to the present. The scenarios were developed in a multi-stage, interdisciplinary process together with the project participants and other stakeholders from science and industry. The first step was to identify potential influencing factors that can impact the SUSKULT vision and are therefore relevant for scenario development. Based on three influencing factors, which have multiple interactions and feedback with the other factors, five different types of scenarios were developed in the form of short stories.

Preliminary note: Scenarios are not forecasts. They do not aim at precise values or probabilities of occurrence. Based on the subjective and collective assumptions made, they are intended to show the possible paths of development and identify causal chains. These scenarios can provide a basis for further discussion of the concept and the derivation of necessary recommendations for action. All persons named in the case studies are fictitious.



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## 30 years of SUSKULT- A look back at a success story



For over 30 years, the SUSKULT concept has been writing success stories in the year 2050. What began as a research project with 15 project partners shortly before the end of the second decade of the 21st century is now a widespread food production system across nearly half of major cities in Germany. The concept is based on recycling and recovering nutrients from sludge water from sewage treatment plants. In a highly efficient and water-based (hydroponic) on-site food production system, recycled nutrients are used to grow vegetables. Initial consumer skepticism was the biggest challenge of the project, as long-term project leader Volkmar Keuter of Fraunhofer UMSICHT once said in an interview looking back on the project.

This innovative concept is already providing early solutions to pressing societal challenges in a highly urbanized environment affected by climate change. Where traditional agricultural methods are increasingly challenged by more frequent heavy rainfall and longer droughts, SUSKULT offers a food production system that can produce tomatoes, lettuce, sweet potatoes, or duckweed with high efficiency and low land use, even in urban areas. At the same time, nutrient recycling makes a significant contribution to the urban circular economy by addressing the increasingly important issue of resource scarcity. Phosphorus, a nonrenewable raw material that is indispensable as a fertilizer but is only available in very small quantities in Europe, was of particular interest to project stakeholders. Phosphorus is found in domestic wastewater and can now be efficiently recycled thanks to SUSKULT.

Urban vegetable production is based on hydroponic systems. A nutrient solution recovered from treated wastewater provides plants with all the necessary nutrients, which are partially or completely absorbed by the roots without the use of soil.

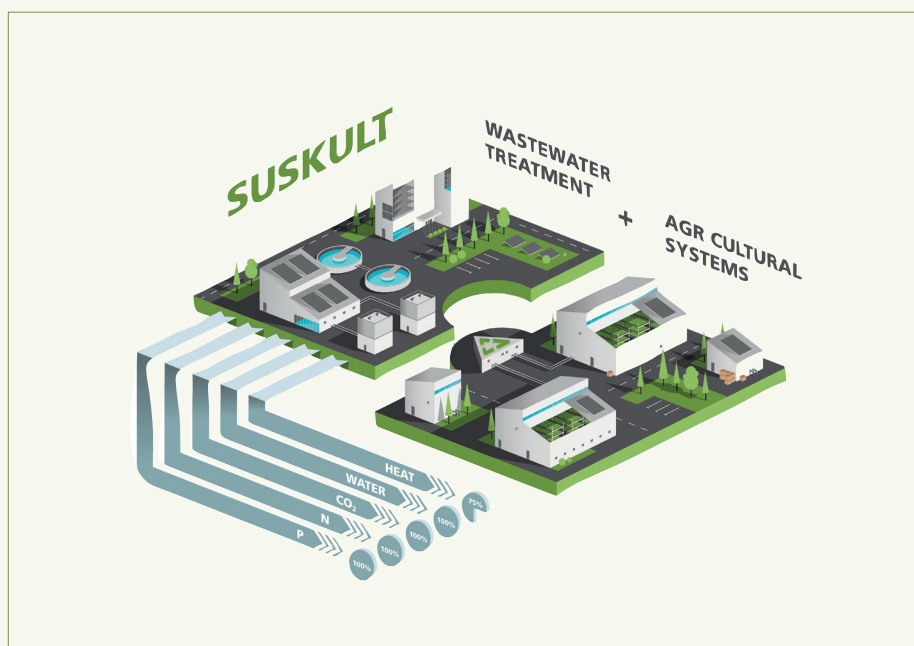


Photo 1: Schematic representation of the SUSKULT concept

Optimal growth conditions are also created through automated control of environmental conditions. Targeted light control using specially developed LED technology and a constant indoor climate results in shorter vegetation periods and thus more frequent harvests. In addition, the use of LED light modules allows vertical cultivation (spread over several floors), which also increases space efficiency.

The Emschermündung wastewater treatment plant (KLEM) was selected 30 years ago as a model wastewater treatment plant and was converted into a NEWtrient® center. In 2018, the model plant on the border of the cities of Dinslaken, Duisburg, and Oberhausen had a capacity of 2.4 million population equivalents (p.e.). Originally built in 1976 on a greenfield site, the plant is now situated within an integrated urban area.

The site is bordered to the west and south by terraced houses and apartment blocks in the Duisburg-Wehofen district. To the north is the Barmingholten Innovation Quarter that was developed in cooperation with the cities of Dinslaken and Oberhausen. It combines modern living and working concepts, including multifunctional buildings with flexible room layouts, decentralized shared offices, intergenerational living and care units, and building structures for an urban digital world. To the east, on the other side of the River Emscher, there are no residential areas, only a large field of rainwater retention basins for the increasingly frequent heavy rainfall. These basins are also covered with solar panels in the spirit of multifunctionality. Today, the central, integrated urban location of the treatment plant allows food to be produced and distributed close to consumers and is well accepted. Strong population growth in urban centers over the past two decades has meant that KLEM's capacity utilization is now close to 90% (compared to about 70% in 2020).

However, the SUSKULT project had to overcome several challenges to become the success that it is today.



Photo 2: View of a wastewater treatment plant in 2022

In particular, building trust and acceptance among the local population for the food produced in and around the NEWtrient® center required considerable effort.

Thirty years ago, food products from the circular economy were hardly available and therefore not in demand. Technical and legal conditions had to be created to facilitate change. This required the cooperation of actors who had previously had little contact with each other to realize the concept of food production on a sewage treatment plant.

The individual examples illustrate this. With the revision of the Sewage Sludge Ordinance in 2017, individual pilot projects for the recovery of phosphorus from sewage sludge or the recovery of nutrients from sewage sludge or sewage sludge ash will become possible.

Today, the numerous NEWtrient® centers produce at least 30 to 40 tonnes of vegetables (mainly tomatoes, lettuce, sweet potatoes, and duckweed) per 1,000 m<sup>2</sup> of cultivation area per year, which are successfully distributed locally and regionally over short distances.



Photo 3: Hydroponic vegetable cultivation

In this issue, we would like to take you on a brief journey through 30 years of SUSKULT development, which has seen many challenges and successes. Several practical examples show the flexibility of the SUSKULT concept and the different approaches that it offers to local conditions.

## SUSKULT tomatoes on everyone's lips these days

Today, in 2050, it is normal to buy regionally-sourced vegetables such as tomatoes and sweet potatoes directly from their place of origin, the Emschermündung sewage treatment plant in Dinslaken. What began 30 years ago as a pilot project is now an everyday reality. Back then, it was difficult for many people to imagine consuming food produced in this way. Today, the advanced technology of SUSKULT plants allows the separation of individual nutrients, which filters pollutants and ensures consistent quality throughout the year. This is essential when growing tomatoes. The technologies are complementary to the fourth treatment stage (which enables the removal of micropollutants, e.g., through powdered activated carbon or ozonation), which was retrofitted to many wastewater treatment plants in Germany in the 2020s. Sewage treatment plants such as KLEM are no longer unpleasant infrastructures perceived primarily as technical disposal sites but have become modern „NEWtrient® centers“ in which valuable raw materials are reused.

The SUSKULT concept is now established in half of German cities with more than 500,000 inhabitants. The facilities, which are usually integrated into the urban landscape and have a low odor, attract many residents to experience and buy local food. In some cases, this is encouraged by the climate-neutral and architecturally attractive design of the plants.



Photo 4: Visualization of a container module in the sense of the NEWtrient® Center

The Emschermündung sewage treatment plant is accessible to the public along marked routes in compliance with hygiene and safety standards. It offers numerous attractions and hands-on activities that demonstrate the circular economy and production methods of SUSKULT products for all ages

The enormous importance of the circular economy for sustainable development is now firmly anchored in public consciousness thanks to the proven harmlessness of the quality of food from SUSKULT plants and public relations work with virtual tours.

The Foodpath app allows consumers to transparently track the origin and recycled resources of each product using a QR code. From the beginning, the SUSKULT approach was developed to involve stakeholders and civil society in the development process. Even secondary school students can learn about the principles of the circular economy and take a (virtual) tour of the Emschermündung wastewater treatment plant. There is no longer any doubt in the minds of the public of the high-quality foodstuffs.

In addition, SUSKULT products are affordable for citizens and hardly deviate from the usual prices of comparable organic products. This is mainly because the increasing social awareness of the importance of resource recovery has influenced politics to such an extent that an EU-wide legal obligation has been created. In Germany, for example, most municipalities are now legally obliged to implement the fourth treatment stage, and „phosphorus recycling“ from wastewater or sewage sludge has also become standard practice in wastewater treatment plants with a capacity of 50,000 p.e. or more.

The proximity of the production facilities to regional markets and local retailers also reduces logistical efforts, which has a positive impact on the environment and climate through lower CO2 emissions. Direct deliveries to supermarkets in the vicinity of KLEM are made using self-autonomous electric vans, which are approved for speeds of up to 50 km/h, making them suitable for short-distance, climate-friendly deliveries.

## The starting point in 2020

Though larger than average in size, the KLEM model plant was a standard wastewater treatment plant until 2020. Its process flow followed a conventional three-stage treatment process consisting of mechanical, biological, and chemical treatment stages. Phosphorus was removed through biological and chemical means, and the resulting sewage sludge (approximately 22,000 t dry matter/yr) was stabilized on-site anaerobically to produce digester gas. The sewage sludge, along with that of the Duisburg Emscher sewage treatment plant, was transferred to Bottrop for dewatering and incineration through a sludge pipeline. Consistent removal of nutrients from the wastewater was ensured, but the valuable nutrients were not recycled. During that period, KLEM lacked a fourth treatment stage to eliminate drug residues from the wastewater. This addition occurred in multiple locations as a part of the nationwide „Zukunft WasserNexus“ investment program toward the end of the 2020s. During the initial two decades of the 21st century, society was just beginning to develop awareness regarding micro-pollutants in wastewater and groundwater.

The SUSKULT project aimed to transform wastewater into a high-quality, nonhazardous resource. Despite a lack of knowledge about the circular economy in society and associated scepticism about



Photo 5: Hydroponic cultivation of lettuce

unknown production methods, the SUSKULT project was in line with the increasing awareness of urban resource scarcity.

At that time, the population in the catchment area of the wastewater treatment plant had significantly declined, resulting in the plant operating at approximately two-thirds of its capacity. During that period, over 40% of the wastewater was from commercial sources. Perhaps this was a contributing factor to the relatively low average phosphorus content of 24 g/kg dry sludge. Despite this, the plant was chosen as the model plant in the SUSKULT project. Three decades ago, the site of the large-scale sewage treatment plant was situated near the Wehofen district but it was neither integrated into nor directly

connected to the urban settlement.

Regulations mandating a minimum distance of at least 300 meters to potential residential developments frequently resulted in a spatial divide between sewage treatment plants and residential areas.

The potential for production and commercial sites such as indoor farms has not yet been realized. Consequently, sewage treatment plants were predominantly surrounded by green and arable land. Due to operational and safety concerns, partial public accessibility of sewage treatment plants was still unavailable. The potential of resource recovery and urban agriculture was not yet a priority in urban policy, so the site's land potential of approximately five hectares remained unused.

## The development process of SUSKULT from vision to reality



The first step toward successfully establishing the SUSKULT concept, which took 30 years, was developing the underlying technologies. The development of underlying technologies was central to the SUSKULT concept. In 2019, SUSKULT was launched as an ambitious project for research and development. In 2022, the first model plant was constructed at the KLEM location in Dinslaken.

During plant development, the initial strains of the novel coronavirus emerged. To curb infection and mortality rates and ease the burden on the healthcare system, strict measures were imposed on public life. While the pandemic delayed the project, it enabled the successful testing of SUSKULT's functionality on a laboratory scale in 2021. The concept was soon implemented at KLEM to test under real conditions. Scientists and engineers initially faced significant challenges due to fluctuating feed quantities and nutrient concentrations, as well as the low phosphate load. The project received funding for an additional five years starting in 2024, as the test phase produced promising results. Filter technologies and ion exchangers for nitrogen recovery were optimized to a level that made nitrogen recovery from wastewater profitable from 2027 onward.

Thankfully, the actors involved were able to realize a follow-up project in 2029, which optimized the technologies and supported their transfer to other locations. Simultaneously, with developments in wastewater technology, the agricultural and marketing prerequisites essential for the realization of SUSKULT were created.



Photo 6: Hydroponic greenhouse in the city

Thanks to close cooperation with various scientists, we were able to develop optimized cultivation methods and cultivation systems. Here, we also faced several initial difficulties, mainly in the form of insufficient tuber formation in the now popular SUSKULT sweet potatoes and with large-scale, vertical cultivation of tomatoes. However, we overcame these difficulties by undertaking application-oriented research and development. Early successes in the cultivation of lettuce provided proof that the innovative concept also worked under real implementation conditions.

By 2035, KLEM's SUSKULT container modules were already producing over 300 tonnes of vegetables every year. The productivity per unit area, expressed as yield in kilograms per square meter of cultivated area, was a remarkable four times higher than traditional agriculture, thanks to the vertical cultivation method and controlled environmental conditions. The expected increase in resilience from SUSKULT, as opposed to open-air agriculture, was achieved as planned despite the latter being increasingly affected by intense heat, long dry periods, and heavy rainfall events.

It was not guaranteed that the salads, tomatoes, sweet potatoes, and duckweed produced at KLEM would end up on consumers' plates by 2035. Instead, this was the outcome of additional processes initiated in the background during the 2020s by the SUSKULT project and other related circular economy research projects involving social, political, and planning scientists. To promote the model plant, a public relations campaign was launched in 2022 to raise the public's collective consciousness regarding the circular economy. As a result, it was successfully conveyed to the public that modern technologies could safely solve the issue of trace substances in wastewater, leading to a significant „nutrient opportunity“ that should be utilized in the context of urban resource scarcity. Additionally, educational campaigns such as those run by the Emschergerossenschaft stressing the importance of disposing of medicines through residual waste (instead of flushing them down the toilet) have been quite successful. The presence of medicine residues in wastewater has substantially decreased.

Thankfully, the climate protection movements in the late 2010s, including Fridays for Future, initiated a shift toward more sustainable lifestyles and higher priority to resource recovery efforts. This formed a solid basis for promoting innovative processes in the circular economy. Requiring individual nutrient balances to be listed on wastewater notices in North Rhine-Westphalian cities from 2025 may have also contributed to raising awareness. The opening of the visitor center at KLEM, where production processes take place in a transparent and traceable manner, also boosted the growing acceptance of SUSKULT products. Initial uncertainties surrounding the cultivation of vegetables at and on sewage treatment plants have been largely



Photo 7: Visitor Center

resolved among the public. Moreover, during the revision of the 2030 EU Organic Regulation, SUSKULT products became eligible for certification as organic. Consequently, by 2035, the products were included in organic farming associations such as Bioland or Naturland, which certify not only soil-related humus management but also resource-conserving food cultivation. It quickly became apparent that skepticism was due to a lack of understanding of the processes. There was, however, a keen interest in the adoption of more sustainable production methods. Delayed or disrupted supply chains due to the COVID-19 pandemic in the early 2020s resulted in a high demand for and increased awareness of sustainable and regional food.

SUSKULT gained even more attention after receiving the German Design Award 2030 for the innovative hybrid concept of the digital exhibition and concrete visual materials at the visitor center. By partially opening up the KLEM and the visitor center for public access, SUSKULT was able to demonstrate the harmlessness of its entire production process and products. Details regarding this circumstance

can also be tracked digitally at any time using the Foodpath app.

Growing social acceptance and the increasing impact of climate change on food production has put mounting pressure on policymakers. Toward the end of the 2020s, a legal framework was incrementally established to implement the SUSKULT concept in numerous cities throughout Germany. A major challenge in this process was to establish relationships between policy areas that historically had low interdependencies. The incorporation of new cooperation structures in areas of agriculture and wastewater policy was crucial to achieving this aim. Finally, nutrient recovery was included as a central topic in agricultural policy. Since then, SUSKULT technology has been eligible for funding under the common funds of the EU's agricultural policy schemes. These schemes can be accessed through national funding programs. Furthermore, the Closed Substance Cycle, Agriculture and Food Act has integrated regulations on the use of nutrients from wastewater in the production of vegetables.



Simultaneously, subsidies facilitated the creation of NEWtrient® centers and SUSKULT plants. Consequently, SUSKULT GmbH was established as a joint venture between employees from agriculture, agricultural technology, wastewater associations, and retail. Today, they have successfully distributed products to various locations throughout Germany. This illustrates the entrepreneurial innovation that can arise from novel collaboration structures.

Initially, distribution was successful for the KLEM model plant in Dinslaken despite not being overseen by a distribution company. This was due to the participation of two retail and wholesale companies, namely, Rewe and Metro, which organized the distribution on a model scale. By the end of the funding period, supply chains had been established for local direct distribution. This enabled the products to be offered in the supermarkets of the neighboring districts of Dinslaken and Duisburg. Demand initially remained low, but increased rapidly with successful publicity campaigns and decreased prices due to larger production quantities.

The legal regulation of food cultivation from recycled nutrients has resulted in the creation of a new specialization within agricultural-technical training professions. New modules have been included in the curricula that cover the entire process of nutrient recovery and hydroponic agriculture. Moreover, the „Green Infrastructure 2030 Offensive“ aimed at establishing a harmonized network of green and



Photo 8: SUSKULT vegetables at the weekly market

open spaces in the Ruhr region. As early as 2035, the concept of the circular economy was integrated into primary school curricula for biology, geography, and science. This initiative was also informed by the highly successful collaboration between Emschergenossenschaft, the operator of the KLEM sewage treatment plant, and selected schools in Dinslaken and Duisburg. These educational experiences were integrated into the curriculum and informed the design of the visitor center at KLEM.

To date, SUSKULT has succeeded in establishing itself as a sustainable and safe food production system that addresses both climatic and social challenges. Furthermore, significant technical advancements have enabled efficient and resource-saving food cultivation, even under partially changing environmental conditions in urban areas.

The products are well established in society because they do not impose any restrictions on consumers. They are not only delicious, fresh, and affordable but also regionally and sustainably produced. In addition, SUSKULT products have greater price stability, in contrast to the high price volatility of imported vegetables from other regions of Europe and overseas. Because hydroponic systems are largely isolated from the outside world, pest pressure can be reduced, and the use of chemical pesticides can be largely avoided. These are essential characteristics of food products demanded by a new generation of consumers who are increasingly questioning their role in the urban resource cycle.

## Why the SUSKULT concept is successful

The transfer of the SUSKULT concept from the laboratory scale to real conditions at KLEM has made it clear that site-specific technical optimization is necessary for the system to function as efficiently as possible. Since the nationwide establishment of the concept was always an objective of the project, the obstacles and solutions were documented in detail during the implementation phases of the first plants and processed in an online database.

Furthermore, it was immediately clear that the measures for early public participation and increasing acceptance, cooperation with regional food councils, and strong involvement of farmers from the surrounding areas contributed significantly to the long-term success of the concept. The social science institutions involved were also able to demonstrate the importance of their role in the success of the project.

The app-based linking of products and the competitive price-performance level of the food were milestones that increased consumer demand for these products. The transparency of the processes at the treatment plants (through visitor centers and virtual tours) was also rated very positively by citizens according to surveys.

Many citizens perceived that wastewater treatment plants could develop into a kind of „urban raw materials market“ or NEWtrient® centers through greater urban integration and an architecturally appealing design.

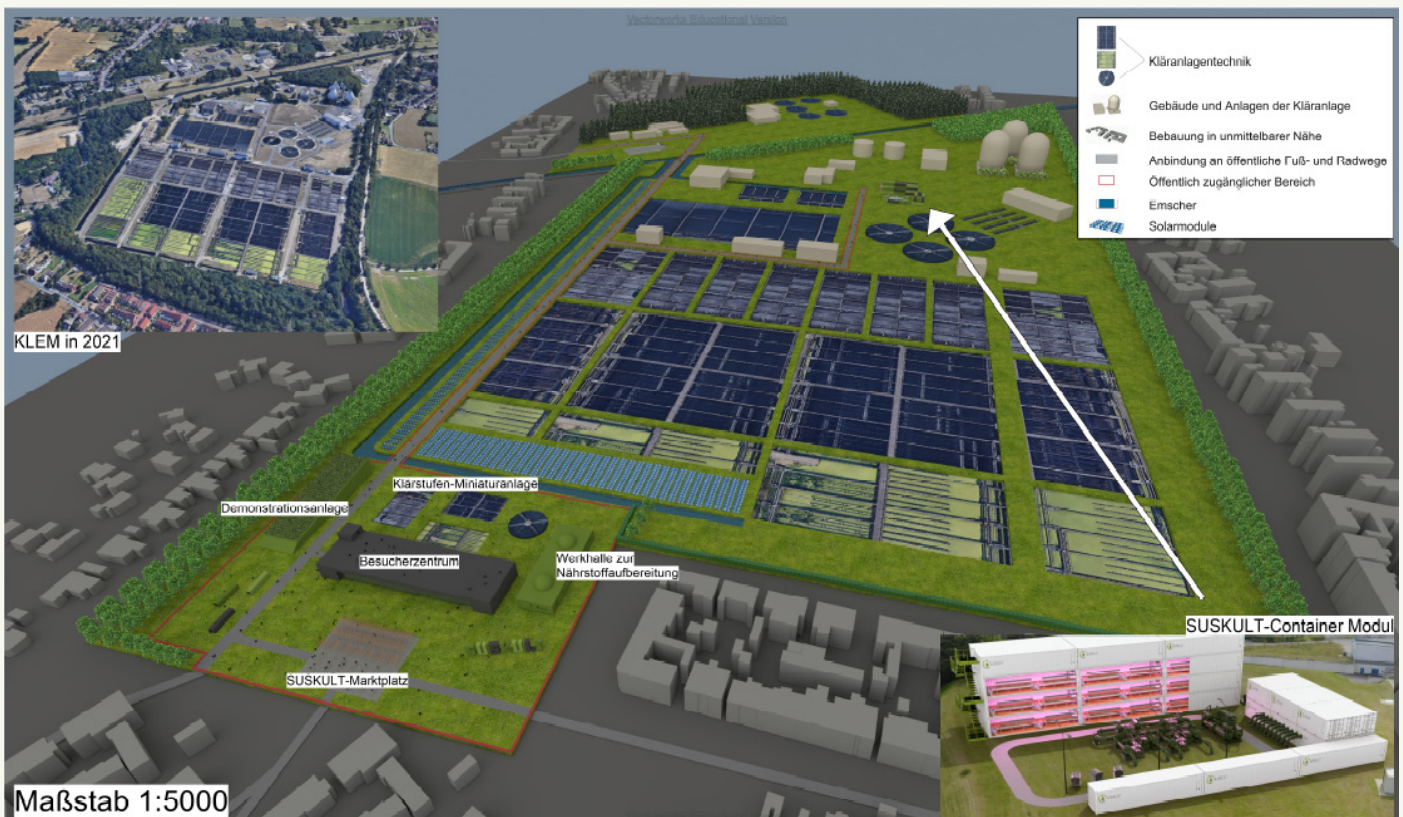


Photo 9: Visitor Center 3D-SUSKULT-Vision at KLEM with NEWtrient® Center in the year 2050

# Practice report Dortmund-Deusen

**Mehmet S.,  
Head of the wastewater treatment plant**



**There is a successful SUSKULT plant in the Deusen district in the north of Dortmund. We became aware of the concept at a very early stage through indirect involvement with the EmscherGenossenschaft and our plant manager at the time was very interested in innovative concepts. Initial discussions between the top management of the EmscherGenossenschaft and the Lippeverband and the engineers from SUSKULT took place in 2025. We quickly came up with a joint concept on how SUSKULT could be technically implemented in Deusen.**

Time was of the essence as funding for the International Garden Show Metropolis Ruhr (IGA) 2027 was to be used to better integrate the plant into the city. The Deusen sewage treatment plant is still located in Dortmund's harbor area, but in the early 2020s, this area was primarily used for industrial and commercial purposes and was not yet an attractive residential area. The transformation of Dortmund's Nordstadt from a social hotspot to today's celebrated model of integration was just beginning, and the harbor area was still something of an insider tip among investors. It was not until the IGA and the Smart Rhino project that the north of Dortmund transformed as numerous construction measures were implemented. It is precisely this vibrant mix of living, working, educational, cultural, and leisure opportunities that makes the district so attractive to live in. I think the integration of water into urban development has been particularly successful because it preserves the historical heritage of the port and at the same time creates a comparatively pleasant climate in the hot summer months.

The success of the SUSKULT concept is owed to the sewage treatment plant being increasingly integrated into the district as a result of urban growth and being connected to the cycle path network as part of the IGA 2027, which, among other things, links the new adventure park around the Deusenberg with the modernized Union Quarter and the R1 cycle path. In addition, a „FutureLab“, where visitors could take a multimedia look at the future of the treatment plant, was set up in front of the plant. We assumed that there would be many excited citizens that would be curious about whether our food would come from the treatment plant in the future.

Early cooperation with the food councils of Bochum and Dortmund also contributed to growing acceptance and networking.



Photo 10: SUSKULT burger with sweet potato fries

This is how we came into contact with the two founders of Duckfood, who set up a start-up company for innovative foods in 2030 and were still based in the Union-Gewerbehof at the time. After the two had worked more or less successfully on various meat substitute products, they established contact with the Nutrition Council.

Together, they quickly decided that, from 2035, the Deusen sewage treatment plant would produce mainly duckweed, which Duckfood would then process into various products. Their success was so great that the old industrial premises were soon outgrown, and a separate production facility was later built near the treatment plant.

The final breakthrough for Duckfood came in the 2038/39 season when BVB started selling a stadium sausage made from Dortmund duckweed protein.

The various duckweed products are regional and sustainable, meet modern standards for healthy nutrition by having added vitamins, and are also vegan and halal, which is noteworthy in a neighborhood characterized by diverse cultures and lifestyles. The SUSKULT kebab skewer is already offered as a meat-free alternative in most of Dortmund's kebab shops.

„I remember what happened here in the Südtribüne when the stadium sausage was suddenly made from duckweed. You can't really take away people's stadium sausage. But my son always says: ‚Dad, meat is bad for the climate! And then I tried one of these things, and I'll be honest: it tastes really good! And it's even a bit cheaper than the normal sausage I had last time.“

- Markus W., BVB-stadium visitor, Germany -

Following its expansion and conversion in 2043, the Dortmund-Deusen sewage treatment plant is now so architecturally appealing that it blends in with the surrounding development. The vertical cultivation of duckweed, lettuce, tomatoes, and sweet potatoes above the actual sewage treatment plant would probably go unnoticed by most „cyclists“ if it were not for the small visitor container that allows a digital tour based on a QR code or a physical tour on the „NEWtrient® Centre Open Day.“

The products can also be purchased directly from a vending machine on site. However, our SUSKULT products are mainly sold in local supermarkets. They are easily recognizable by the circular economy seal.

The absolute hit, however, is our popular duckweed burger, which is sold as street food from an Airstream trailer outside the treatment plant. In the NEWtrient® menu, most of the ingredients come straight from the treatment plant. The Duckweed Burger consists of a duckweed protein patty with lettuce, tomato, and sweet potato fries on the side. The ketchup is also made on-site, and the mustard seeds are grown at the treatment plant.



Photo 11: Airstream-Trailer

The mustard crop still needs improvement, but it is a worthwhile addition to the complete NEWtrient® menu. The people of Dortmund love it, and we are working with Duckfood on improvements so that we can hopefully grow all the ingredients for the menu at the sewage treatment plant.

# Practice report Hattingen

Manuela L., head of  
„Urban Roofing Agriculture Initiative“  
Hattingen, Germany



**The SUSKULT concept is not limited to sewage treatment plant sites. In Hattingen, instead of a NEWtrient® center, the focus was on decentralized vegetable production on roofs and in gardens. The city started with a decentralized SUSKULT wastewater treatment plant as a pilot project in the Holthausen district and is now a model city for the Urban Roofing Agriculture Initiative (URAI).**

It is important to note that according to the Municipal Code of North Rhine-Westphalia (NRW), municipalities are generally exempted from the usual obligation to provide a central connection (e.g., in certain parts of the municipality). However, this only applies to a very small proportion of households in NRW and in Germany as a whole. Therefore, this is more of an innovation model for water supply and sanitation. In individual cases, there may also be a combination of centralized and decentralized water management.

Due to its urban location on the edge of an industrial area, it was decided in the early phases of the SUSKULT project to designate Hattingen a special role. The already high acceptance of urban agriculture products among the population of Hattingen due to long-standing urban agriculture initiatives enabled the project participants to start a decentralized pilot project for material flow separation in Hattingen's Holthausen district.

In Holthausen, a decentralized wastewater system for several hundred residential units (including material flow separation) was installed in a new development area in 2028. It should be noted that this was a pilot project that would not have otherwise been feasible at this scale, particularly from an economic point of view. As a result, we were able to obtain funding from the federal government's „Zukunft WasserNexus“ programme, which made this investment possible. The installed system enables gray and rainwater to be reused directly on-site, even in more urban districts. In this way, modern sanitation systems enable the actual separation of material flows already in the household. Low-pollution gray water can be reused on-site, for example, as toilet flush water. Only black water is sent to the nearby treatment plant.



Photo 12: Urban Gardening

Following the establishment of other urban forms of cultivation throughout NRW, public interest in producing their fruit and vegetables has grown over the last 25 years. As part of a SUSKULT follow-up project, researchers in cooperation with SUSKULT GmbH took this opportunity to launch the now popular „SUSKULT Production Kit“ in 2032. This enables hobby gardeners to produce vegetables with SUSKULT nutrients in their gardens or on the roofs of their houses. Decentrally collected rainwater can be used for vegetable production in gardens using a pumping system, which can be installed on request, after prior plant filtration. Only the necessary nutrients need to be added externally. This is easily done with the „SUSKULT Refill Kit.“ With this kit, the nutrient solution can be replenished directly from a vending machine at the decentralized treatment plant, or the kit can be refilled at one of the surrounding garden centers. Since then, many residents of Hattingen-Holthausen have developed their gardening skills.



Photo 13: Growing vegetables on a rooftop

Early on, in the Holthausen Sustainable Vegetable Production Initiative, which was founded in 2033, isolated networks of residents and market vendors formed to reduce food waste.

Any excess produce or vegetables that cannot be sold on the market are donated to the food bank or people in need and lectures, residents have been made aware of their important role in the food cycle and the process of consumers becoming producers (“prosumers”).

Hattingen has a farmers’ market every Wednesday and Saturday. Since then, the food bank has sufficient food supplies and the population has reduced food waste. Today, about a third less food is being thrown away than in 2024, in part because of initiatives to raise consumer awareness. Through workshops, seminars, In the mid-2030s, the city of Hattingen became a model city for the Urban Roof Agriculture Initiative (URAI). In addition to providing urban allotment gardeners who have the necessary know-how to cultivate their vegetable gardens, the URAI enables property owners who support the idea but who do not want to or cannot cultivate the areas themselves to make space available for gardens (e.g., flat roofs). Today, about one in five homeowners in Hattingen-Holthausen grow their own SUSKULT vegetables on the roofs of their houses or garages.

The plants are maintained, inspected, and serviced by central management with responsible technical staff. Today, following the example of the model city, approximately 500,000 people in Germany are implementing the SUSKULT cultivation method on a decentralized basis and their numbers are growing. What a success!

# Practice report Bottrop

Julia P., Spokesperson Emschergenossenschaft/  
Lippeverband, Germany



**At the Bottrop wastewater treatment plant, we also tried to implement the SUSKULT vision. In the end, however, we had to forge our own path because the conditions here are very different from those at other plants. Once the concept had been successfully implemented at KLEM, the next logical step was Bottrop.**

While allowing public access or even having a visitor center was not planned for the Bottrop plant, there was already basic confidence in the feasibility of the SUSKULT vision here. By the end of the 2020s, we had a modernized plant that was designed for approximately 1.6 million population equivalents after expansion as well as a fourth treatment stage and industry-leading equipment for sludge utilization. To this end, a large-scale phosphorus recycling plant for sewage sludge ash was installed in 2029, enabling more sustainable use of the residual materials from central sewage sludge incineration. The idea of feeding the phosphorus recovered from the sewage sludge ash into a SUSKULT system and thus expanding the associated hydroponics was naturally obvious.



Photo 14: Plant breeding resources

Fittingly, the Climate Change Act of 2024 led to the complete phase-out of coal-fired power generation by 2034. For our plant in Bottrop, this meant that large areas of the Prosper coking plant and the coal port in the immediate vicinity became vacant as a result of the necessary dismantling. As the population of Bottrop and demand for housing declined sharply at the time, we were able to buy parts of these areas and use them for urban agriculture.

By 2038, several hundred tonnes of vegetables will be produced annually in and around the Bottrop plant and distributed throughout the region. Together with the „InnovationCity Bottrop,“ SUSKULT was supposed to grow as a lighthouse project for urban recycling management. The fact that things turned out a little differently and that the SUSKULT plant in Bottrop now looks a little different is mainly due to two factors:

1. Over the past two decades, the population of the surrounding districts has declined significantly. Instead of expanding the settlement area, some areas have been demolished and left to nature.

As a result, the site is quite far from the nearest residential areas. However, in today's „15-minute city,“ people are used to doing their shopping in the neighborhood without a car. Therefore, in Bottrop, we simply lacked accessibility to potential customers. The critical regional relationship between producers and consumers has not developed.

2. In 2035, while we were still in the process of establishing our products in the retail environment, we, unfortunately, had an incident. A technical system error, which was initially thought to be minor, eventually led to major system failures. This meant that we had to suspend a growth cycle and were unable to deliver products for two months, despite a major advertising campaign. Our transparent explanation of this was intended to educate and build confidence in the system's mechanisms, but it attracted much media attention. Although the SUSKULT system technology was subsequently modified and is now subject to even stricter controls, the Emschergenossenschaft and SUSKULT GmbH jointly decided to halt food production at the Bottrop site.

However, new sales channels soon opened up. As the neighboring RWE power station was to be converted into a modern biogas plant by 2037 as part of the inter-municipal Freedom Emscher development concept, the hydroponic cultivation method was adapted to suit the cultivation of typical crops with high biomass productivity. As a result, by 2039, our fields will be able to grow energy-optimized crops, which will be converted into biogas in the adjacent plant and then into ecologically sustainable bioenergy. As the production of the nutrient solution far exceeded the regional demand, despite the short growing cycles of the evergreen crops, the solution is now being sold elsewhere.



Photo 15: Liquid fertilizer on a laboratory scale

On the one hand, as a liquid fertilizer for traditional agriculture, the nutrient solution has been experiencing difficulties since the mandatory restrictions on the use of sewage sludge and animal manure and the global phosphorus crisis. On the other hand, since 2045, we have been selling Bottroper liquid fertilizer, which is specifically optimized for different types of crops, throughout Germany. At the moment, there is even talk of exporting to the Benelux countries because the demand in Germany has been saturated and there is economies of scale in production. The sustainability of these export structures is a key criterion in the discussions.

Another mainstay of our fertilizer range is the concentrated SUSKULT solid fertilizer, which is already opening up the market for urban organic farming—the new culture of urban gardening. Compared to liquid fertilizer, solid fertilizer is easier to transport, easier to dose, and more durable.

As shown, there are many ways to adapt the SUSKULT concept to local conditions and overcome difficulties. As with all innovations, all it takes is a few good ideas and a little courage to implement them. As this was and still is the case in Bottrop, we can now make our contribution to a sustainable urban resource cycle.



# Practice report Schwerte

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**The SUSKULT concept is also used in Schwerte and has been supported and successfully promoted by our „Sustainable Producing City“ department for many years. To briefly explain why the conversion of the wastewater treatment plant in Schwerte into a NEWtrient® center was seen as an opportunity for our city, SUSKULT presented an alternative fertilizer production option at the beginning of the 2020s.**

The project was seen as a way out of the global supply and demand situation at the time, particularly in terms of a more sustainable supply and use of phosphorus. At the time, Morocco accounted for three-quarters of the world's phosphorus reserves, although the mining practices had long been criticized. This high market concentration could have led to an increased supply risk in Germany in the long term, so alternatives were sought in the agricultural sector for phosphorus recovery. Phosphorus fertilizer as a recycled product from wastewater was a proactive response to this challenge. The city of Schwerte was very interested in being part of this innovative agricultural production system and in familiarizing the population with SUSKULT.

The early establishment of a visitor center around the site of the Schwerte sewage treatment plant helped to raise public interest in sustainably produced food and to overcome initial scepticism.

By the end of the 20th century, the Schwerte wastewater treatment plant was a model plant for the Ruhrverband, which had already piloted a fourth treatment stage using powdered activated carbon dosing and ozonation. Its central location near residents was not necessarily ideal for sewage treatment plants at the time. With a capacity of 50,000 population equivalents and a sludge volume of 937 tonnes of dry matter per year, the plant was already located close to the center of Schwerte in 2020. It was surrounded by detached and semidetached houses as well as commercial and retail areas to the west and north, meadows and agricultural land to the south and the River Ruhr to the east.

Today, as a NEWtrient® center with an integrated visitor center „SUSKULT-Experience“, the sewage treatment plant is even more integrated into urban development and is listed as a kind of leisure attraction in the town of Schwerte and as part of the industrial route.

However, 30 years ago, the plant was not open to the public. After numerous discussions with the Ruhrverband, a concept was developed that would allow individual tours with the necessary safety precautions, such as fencing off individual areas of the plant. However, obtaining planning permission for the visitor center around the site proved to be extremely challenging, as numerous traffic safety measures had to be implemented first. The lessons learned from the SUSKULT pilot plant, which are summarized on the website, also helped.

In 2031, with increasing public pressure on politicians, final planning permission was granted, and construction of the visitor center could begin. Completed three years later, the visitor center uses a hybrid and digital information concept to familiarize visitors with the production method.

After a cautious start, the “SUSKULT Experience” quickly became a major attraction in the area, largely due to its exceptionally futuristic architectural style, which many visitors see as the epitome of climate-smart architecture. Using play, the SUSKULT Experience introduces children to the production of sustainable, regional, and fresh SUSKULT products and to the importance of the circular economy for a sustainable way of life. The guided tours and tastings on site are also highly engaging and informative leisure activities for adults.

Although visitors were initially skeptical about the health safety of SUSKULT products, there was a great deal of interest in the new production methods. However, with the transparent presentation of the production processes in the visitor center, we quickly succeeded in creating trust. Events such as the „Open Day at the NEWtrient® Centre“ attracted visitors from near and far to Schwerte to convince them of the sustainable cycle products. When the first school classes were invited to take a free tour shortly after the opening in 2034, the reservations about products from the circular economy subsided, and an increasing number of visitors flocked to the visitor center around days off. Long queues formed, especially on weekends, to „see for themselves“ how sustainable food could work in the cities of the future. However, the waiting time is shortened by fresh snacks produced on-site. Visitors who were interested in the products were allowed to take a „piece of SUSKULT“ home with them via the SUSKULT vending machine, located directly at the wastewater treatment plant.

The rush to the weekly market stall prompted the operators to set up more market stalls and start selling SUSKULT products in nearby supermarkets.

The introduction of space-efficient, urban NEWtrient® centers in many cities in North Rhine-Westphalia (NRW) has also encouraged urban planners to think more sustainably. With the reform of the Climate Protection Act in 2024 and the German government's national climate protection initiative for energy efficiency in buildings in 2025, additional resource-saving concepts have been developed. Additionally, since 2019, the impact of the COVID-19 pandemic transformed energy, transport, and digitalization, and a new way of thinking in urban planning has been achieved. This is also reflected in the changing face of Schwerte.

As the pandemic progressed, online retailing continued to gain momentum, accompanied by the closure of many retail outlets in German city centers. Medical care was also increasingly provided digitally. In addition, working from home was a popular working model for many companies, which in turn increased the demand for smaller office space, which is clearly demonstrated by the rising demand for city center commercial space since 2024.

The rethinking of companies toward a space-saving, resource-conserving, and sustainable corporate culture has been used as an opportunity to promote the mix of uses in inner cities.



Photo 16: Vending machine for fruit and vegetables

This qualitative and quantitative change in the demand for residential and commercial space was also clearly felt in the center of Schwerte from 2030 onwards. More flexible office concepts have been developed as a result of increasing digitalization in almost all areas of basic services. Google was one of the pioneers. The company used the impact of the COVID-19 pandemic as an opportunity to transform its offices with flexible, adaptable workspace concepts. Since then, pop-up walls, mobile office furniture, and mobile heating and ventilation systems have allowed employees to create a working environment that suits their individual needs. The city of Schwerte followed suit and redesigned empty buildings with flexible office concepts. For large, vacant, and old buildings that were unsuitable for flexible office use, the SUSKULT extension method was implemented in 2035 as an interim purpose.

In addition, almost all flat roofs in the center of Schwerte are now used either for growing vegetables or for producing solar energy, following the German government's decision to make the use of flat roofs mandatory for public and commercial buildings by 2042. The management and maintenance of the SUSKULT systems, whether inside or outside buildings, is organized by a central operating company.

As shown by its success in the city of Schwerte, the concept of SUSKULT can also be realized as an urban form of production in inner cities.